Marconi
Instruments

2957A

RADIO TEST SYSTEM for AMPS

Operating Manual

MP MASTER
MA31145

Operating Manual

H 52957-901B
Volume 1

RADIO TEST SYSTEM

2957A

for AMPS

Part no. 52957-901B (with 2955)
52957-910U (with 2955A)
52957-321Z (with 2955R)

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ASSOCIATED PUBLICATIONS

Programming Manual (H 52957-901B Vol. 1A)	Part no. 46881-981M
Service Manual (H 52957-901B Vol. 2)	Part no. 46881-982C

PREFACE

The Radio Test System 2957A consists of a Radio Communications Test Set 2955 series with a Cellular Adapter. The Cellular Adapter includes software for AMPS.

AMENDMENT STATUS

Each page bears the date of the original issue or the date and number of the latest amendment. Any changes subsequent to the latest amendment are included on Manual Change sheets coded C1, C2 etc.

HAZARD SYMBOLS

The following symbols appear on this equipment.

Symbol	Type of hazard	Reference in Manual
	Dangerous voltages	Page v
	Lithium battery	Page vi
	Cathode ray tube	Page vi
or	Static-sensitive components	Page vi
	Input overload	Page vi

WARNINGS, CAUTIONS AND NOTES

The following terms have specific meanings in this Manual.

WARNINGS contain information to prevent personal injury.

CAUTIONS contain information to prevent damage to the equipment.

Notes contain important general information.

INTEGRITY SEALS

If, during the warranty period of this product, an integrity seal is broken, by removing covers for example, the warranty may be invalidated.

Similarly, if a module with a broken seal is returned on an exchange basis, it will not be acceptable under the terms and conditions of the exchange service.

OPERATING PRECAUTIONS

This product has been designed and tested in accordance with IEC Publication 348 - 'Safety Requirements for Electronic Measuring Apparatus' To keep it in a safe condition and avoid risk of injury, observe the following **WARNING** notices. To avoid damage to the equipment, observe the **CAUTION** notices.

WARNING - ELECTRICAL HAZARDS

AC supply voltage

This equipment conforms with IEC Safety Class 1, meaning that it is provided with a protective earthing lead. To maintain this protection, the mains supply lead must always be connected to the source of supply via a socket with an earthing contact. Make sure that the earth protection is not interrupted if the supply is connected through an extension lead or an autotransformer.

Before fitting a non-soldered plug to the mains lead, cut off the tinned end of the wires. Otherwise, cold-flowing of the solder could cause intermittent contact.

Do not use the equipment if it is likely that its protection has been impaired as a result of damage.

Fuses

Note that there are supply fuses in both the live and neutral wires of the supply lead. If only one of these fuses were to rupture, certain parts of the equipment could remain at supply potential.

Make sure that only fuses of the correct rating and type are used for replacement. Do not use mended fuses or short-circuited fuse holders.

To provide protection against breakdown of the supply lead, its connectors (and filter if fitted), an external supply fuse with a continuous rating not exceeding 6 A should be used in the live conductor (e.g. fitted in the supply plug).

Removal of covers

Disconnect both the AC and the DC supplies from the 2955 and/or the Adapter before removing the covers so as to avoid the risk of exposing high-voltage parts. If any internal adjustment or servicing has to be carried out with the supply on, it must only be performed by a skilled person who is aware of the hazard involved.

Note that the SUPPLY switch on the Adapter does not disconnect the DC supply.

Remember that capacitors inside the equipment, including any supply filter capacitors, may still be charged after disconnection of the supply. Those connected to high-voltage points should be discharged before carrying out work inside the equipment.

This applies particularly to the EHT circuit for the cathode ray tube which must be discharged by repeatedly shorting the final anode lead to the chassis or by using a bleed resistor. The residual charge on the CRT itself should also be removed by shorting the anode connector to the chassis.

WARNING - OTHER HAZARDS

Parts of this equipment are made from metal pressings. Therefore, it should be handled with due care to avoid the risk of cuts or scratches.

Some of the components used in this equipment may include resins and other materials which give off toxic fumes if incinerated. Take appropriate precautions, therefore, in the disposal of these items.

A Lithium battery is used in this equipment. This presents two hazards:-

(i) As lithium is a toxic substance, the battery should in no circumstances be crushed, incinerated or disposed of in normal waste.

(ii) If the battery is rapidly charged or discharged, there is a risk of explosion. Take care, therefore, to avoid short-circuiting it.

Cathode ray tube. When exposing or handling the tube, take care to prevent implosion and possible scattering of glass fragments. Handling should only be carried out by experienced personnel and the use of a safety mask and gloves is recommended. A defective tube should be disposed of in a safe manner by an authorized waste contractor.

CAUTION - STATIC-SENSITIVE COMPONENTS

This equipment contains static-sensitive components which may be damaged by handling. Refer to the Service Manual for handling precautions.

CAUTION - INPUT OVERLOAD

When testing a transmitter, an input overload is indicated by the message 'REMOVE RF INPUT' and an audible warning. Failure to respond could result in damage to the equipment.

CAUTION - TILT FACILITY

When the instrument is in the tilt position, it is inadvisable, for stability reasons, to stack other instruments on top of it.

Chapter 1

GENERAL INFORMATION

INTRODUCTION

The Radio Test System 2957A consists of a Radio Communications Test Set 2955 series with a Cellular Adapter.

The 2957A provides DC, audio and RF test facilities for testing cellular mobile radios and it provides the signalling for base station simulation. The 2955 and the Cellular Adapter are fitted together to form one transportable instrument.

On powering up, the 2957A behaves like a normal 2955. This is indicated by a LED above the Cellular Adapter's 2955 key. To invoke the 2957A operating modes, the Cellular Adapter's CRTS key is pressed. The first time that this is selected after each power-on, a self test and calibration sequence is initiated. This ensures that the 2955 and the Cellular Adapter are functioning correctly.

Fig. 1-1 Radio Test System 2957A

Operating modes

The 2957A offers three modes of operation as follows:-

(a) GO/NO-GO TEST.
(b) FULL AUTO TEST.
(c) MANUAL TEST.

The GO/NO-GO TEST mode offers the user a rapid start to running a sequence of test routines. The results are summarized on the screen as a single line of information per test routine. If necessary, the display scrolls. However, the failed results remain on the display. This eliminates the need for continuous attendance.

Most of the selections and settings are set up in the FULL AUTO TEST mode. This mode offers the user a series of easy menus which allow many of the parameters, the sequence of test routines, the display and the 2957A's interfaces to be altered. Sets of settings can be stored or recalled in this mode allowing rapid changes to be made between mobile types. A sequence of test routines can then be run in this mode.

The MANUAL TEST mode offers manual control of the 2957A's base station simulation. This is particularly useful when fault-finding or adjusting.

The 2955 mode can be selected at virtually any point of the 2957A's operation. This allows all of the 2955 measurements to be made. Signals are maintained to ensure that the mobile remains in conversation.

Test sequences

For the GO/NO-GO TEST mode and the FULL AUTO TEST mode, the 2957A automatically executes a chosen test sequence. There is a choice of four built-in sequences.

The combination of selectable test modes and test sequence gives a great degree of flexibility and allows the user to define an area and depth of testing.

In addition to the four built-in test sequences, the user can define his own test sequences. This is done using a learn mode in remote control using the GPIB or through the RS-232 port. One user-defined test sequence can be stored within the instrument in non-volatile memory. Up to ten of them can be stored on a floppy disc when a disc drive is connected.

Test routines

Each test sequence consists of a number of individual test routines.

Pause facility

For when it is necessary to diagnose a fault or to carry out repairs and alignment, the 2957A provides a pause facility. This shows simultaneously the transmitter and receiver RF and AF parameters and the current test results.

When the 2957A is in the paused condition, the 2955 can be selected. This allows manual control for alignment and fault finding purposes.

Displays of signalling data

Another feature of the 2957A is the ability to look at the signalling data which is sent between the mobile and the 2957A. Thus, the signalling data transmitted and received by the mobile can be seen and each frame can be examined in detail.

Standard interfaces

The Adapter carries GPIB, RS-232, Centronics parallel and disc interface connectors. The GPIB port or the RS-232 port can be connected to an external controller to form a sophisticated ATE system. Alternatively, one of these or the Centronics parallel port can be used to drive a printer. The disc interface port is compatible with a 5.25 or 3.5 inch single-sided or double-sided disc drive. The disc drive can be used to down-load previously-written user-defined test sequences.

PERFORMANCE DATA

General AMPS system information

Number of channels

20 MHz AMPS	666.
25 MHz Extended AMPS	832.

Allocation of channels

1 to 333:	System A.
334 to 666:	System B.
667 to 716:	System A'.
717 to 799:	System B'.
800 to 990:	Reserved.
991 to 1023:	System A''.

Dedicated control channels

313 to 333:	System A.
323 to 354:	System B.

Mobile transmit frequency

channel 1:	825.030 MHz.

Mobile receive frequency

channel 1:	870.030 MHz.

Duplex offset: 45 MHz.

Channel spacing:	30 kHz.
Voice deviation FM:	±12 kHz maximum.
Data deviation:	±8 kHz ±10%.
Data type:	FSK Manchester encoded, BCH parity.
Data rate:	10 kbit/s ±1 bit/s.
Supervisory audio tone frequencies:	5.970, 6.000 and 6.030 kHz.
SAT deviation:	2 kHz ±10%.
Signalling tone frequency:	10 kHz ±1 Hz.
Signalling tone deviation:	8 kHz ±10%.
Signalling tone duration:	50 ms, 400 ms or 1.8 s ±10%.
Other tones:	DTMF sent in conversation from mobile by pressing key pad.
Noise measurement filtration:	C-message psophometric.

Mobile transmit power

Class 1:	Power level 0	2.82 W.
	Power level 1	1.12 W.
	Power level 2	447 mW.
	Power level 3	178 mW.
	Power level 4	70.8 mW.
	Power level 5	28.2 mW.
	Power level 6	11.2 mW.
	Power level 7	4.47 mW.
	SCM	XX00.
Class 2:	Power level 0	1.12 W.
	Power level 1	1.12 W.
	Power level 2	447 mW.
	Power level 3	178 mW.
	Power level 4	70.8 mW.
	Power level 5	28.2 mW.
	Power level 6	11.2 mW.
	Power level 7	4.47 mW.
	SCM	XX01.
Class 3:	Power level 0	447 mW.
	Power level 1	447 mW.
	Power level 2	447 mW.
	Power level 3	178 mW.
	Power level 4	70.8 mW.
	Power level 5	28.2 mW.
	Power level 6	11.2 mW.
	Power level 7	4.47 mW.
	SCM	XX10.

System parameter settings

System identity:	5 digits (decimal). Default 00002.
Control channel:	0 to 1023. Default 334.
First voice channel:	0 to 1023. Default 1.
Last voice channel:	0 to 1023. Default 666.
Handoff increment:	1 to 1023. Default 333.
SAT frequency:	5.970, 6.000 or 6.030 kHz. Default 5.970 kHz.
Digital colour code (DCC):	0, 1, 2 or 3. Default 0.

Mobile parameter settings

Mobile number (MIN):	Format xxx-xxx-xxxx. Default 000-000-0000.

Display format settings

Display format:	SUMMARY or FULL. Default FULL.
Pause:	ALWAYS, MANUAL ONLY or ON FAILURE. Default MANUAL ONLY.
Number format:	HEXADECIMAL, DECIMAL, OCTAL, STANDARD 1 or STANDARD 2. Default STANDARD 1.

Test sequence setting

Test sequence:	BRIEF TESTING, COMPREHENSIVE TESTING, CALL PROCESSING ONLY, CALL AND RF TESTING or user-defined (titled NO SEQUENCE DEFINED until title is reset). Default BRIEF TESTING.
DTMF:	ENABLED or DISABLED. Default DISABLED.
Hook flash:	ENABLED or DISABLED. Default DISABLED.

Test sequences

Call processing only:

Registration, Test routine no. 20.
Call from mobile to cell, Test routine no. 22.
(Repeated if failed first time.)
(The following three tests are omitted if failed second time.)
DTMF tones, Test routine no. 30 (if enabled).
Hook flash, Test routine no. 31 (if enabled).
Clear down from mobile, Test routine no. 27.
Call from cell to mobile, Test routine no. 21.
(Repeated if failed first time.)
Automatic handoff, Test routine no. 24.
Clear down from cell, Test routine no. 26.
Print summary.

Call and RF testing:

Registration, Test routine no. 20.
Call from mobile to cell, Test routine no. 22.
(Repeated if failed first time.)
(The following three tests are omitted if failed second time.)
DTMF tones, Test routine no. 30 (if enabled).
Hook flash, Test routine no. 31 (if enabled).
Clear down from mobile, Test routine no. 27.
Call from cell to mobile, Test routine no. 21.
(Repeated if failed first time.)
The following are repeated as many times as necessary to satisfy the channel settings in the system parameters menu (i.e. from the first voice channel to the last voice channel incrementing by the handoff increment) -
Handoff, Test routine no. 23.
Skip on to try next channel if failed.
TX RF power, Test routine no. 28 (power level 0).
TX RF frequency, Test routine no. 2.
SAT deviation, Test routine no. 25.
After the above have been repeated as necessary -
Clear down from cell, Test routine no. 26.
Print summary.
This sequence can be used as a quick test when only an RF connection can be made.

Brief testing:

Registration, Test routine no. 20.
Call from mobile to cell, Test routine no. 22.
(Repeated if failed first time.)
(The following three tests are omitted if failed second time.)
DTMF tones, Test routine no. 30 (if enabled).
Hook flash, Test routine no. 31 (if enabled).
Clear down from mobile, Test routine no. 27.
Call from cell to mobile, Test routine no. 21.
(Repeated if failed first time.)

The following are repeated three times from the first voice channel to the last voice channel incrementing by the handoff increment -

Handoff, Test routine no. 23.
Skip on to try next channel if failed.
SAT deviation, Test routine no. 25.
SAT frequency, Test routine no. 25.
TX RF power, Test routine no. 28 (all levels).
TX RF frequency, Test routine no. 2.
TX AF distortion, Test routine no. 3.
TX limiting, Test routine no. 4.
RX distortion, Test routine no. 6.
RX sensitivity, Test routine no. 7.

After the above have been repeated three times -

Print results.
Clear down from cell, Test routine no. 26.
Print summary.
(The results are printed in a tabular form annotated LOW CHANNEL, MID CHANNEL and HIGH CHANNEL. Three channels are always tested, regardless of the handoff increment etc.)

Comprehensive testing:

Registration, Test routine no. 20.
Call from mobile to cell, Test routine no. 22.
(Repeated if failed first time.)
(The following three tests are omitted if failed second time.)
DTMF tones, Test routine no. 30 (if enabled).
Hook flash, Test routine no. 31 (if enabled).
Clear down from mobile, Test routine no. 27.
Call from cell to mobile, Test routine no. 21.
(Repeated if failed first time.)
Bit error rate, Test routine no. 29.

The following are repeated as many times as satisfies the channel settings in the systems parameters menu (i.e. from the first voice channel to the last voice channel incrementing by the handoff increment).

Handoff, Test routine no. 23.
Skip on to end if failed.
SAT deviation, Test routine no. 25.
SAT frequency, Test routine no. 25.
TX RF power, Test routine no. 28 (power level 7).
DC power, Test routine no. 9.
TX RF power, Test routine no. 28 (power level 6).
DC power, Test routine no. 9.
TX RF power, Test routine no. 28 (power level 5).
DC power, Test routine no. 9.
TX RF power, Test routine no. 28 (power level 4).
DC power, Test routine no. 9.
TX RF power, Test routine no. 28 (power level 3).
DC power, Test routine no. 9.
TX RF power, Test routine no. 28 (power level 2).
DC power, Test routine no. 9.
TX RF power, Test routine no. 28 (power level 1).
DC power, Test routine no. 9.

TX RF power, Test routine no. 28 (power level 0).
DC power, Test routine no. 9.
TX RF frequency, Test routine no. 2.
TX AF distortion, Test routine no. 3.
TX residual noise, Test routine no. 3.
TX limiting, Test routine no. 4.
TX compression, Test routine no. 5.
RX distortion, Test routine no. 6.
RX sensitivity, Test routine no. 7.
RX expansion, test routine no. 8.

After the above have been repeated as necessary -
Clear down from cell, Test routine no. 26.
DC power (quiescent), Test routine no. 9.
Print summary.

Non-system specific test routines

Test routine no. 1	Transmitter RF power
Reference power:	3 W.
Maximum error:	2 dB.
Test routine no. 2	Transmitter RF frequency
Reference frequency:	As currently selected channel.
Maximum error:	2.2 kHz.
Test routine no. 3	Transmitter AF distortion and noise
Filtration:	0.3 to 3.4 kHz.
Lower limit:	26 dB.
Standard modulation level:	8 kHz
Test routine no. 4	Transmitter modulation limiting
Upper limit:	12 kHz.
Overload factor:	20 dB.
Standard modulation level:	8 kHz.
Test routine no. 5	Transmitter modulation compression
Compression ratio:	2 : 1.
Maximum error:	10%.
Standard modulation level:	2.9 kHz.

Test routine no. 6		Receiver AF distortion and noise
	Filtration:	Psophometric C-message weighting.
	Lower limit:	26 dB.
	RF generator level:	-80 dBm.
	Standard modulation level:	8 kHz.
Test routine no. 7		Receiver sensitivity
	Filtration:	Psophometric C-message weighting.
	Upper RF level limit:	-116 dBm.
	Reference SINAD:	12 dB.
	Standard modulation level:	8 kHz.
Test routine no. 8		RX demodulation expansion
	Expansion ratio:	2 : 1.
	Maximum error:	10%.
	Standard modulation level:	2.9 kHz.
Test routine no. 9		DC power consumption
	Upper limit:	100 W.
	Lower limit:	200 mW.
Test routines nos. 10 to 19		(Not implemented.)

System specific test routines

Test routine no. 20		Registration
	RF generator level:	-40, -60 or -80 dB. Default -40 dBm.
Test routine no. 21		Call from cell to mobile
	RF generator level:	-40, -60 or -80 dB. Default -40 dBm.
	Parallel control port:	Answer call (bit 3 = 1).
Test routine no. 22		Call from mobile to cell
	RF generator level:	-40, -60 or -80 dB. Default -40 dBm.
	Parallel control port:	Place call (bit 1 = 1).

Test routine no. 23	Handoff
SAT colour code	Rotated with each handoff (i.e. 0 to 1, 1 to 2 and 2 to 0).
Test routine no. 24	Automatic handoff
SAT colour code	Rotated with each handoff (i.e. 0 to 1, 1 to 2 and 2 to 0).
Test routine no. 25	SAT transponding
Reference deviation:	2 kHz.
Reference frequency:	As SAT colour code (i.e. 0 = 5.970 kHz, 1 = 6.000 kHz and 2 = 6.030 kHz).
Maximum error:	20%.
Test routine no. 26	Clear down from cell
Test routine no. 27	Clear down from mobile
Parallel control port:	End call (bit 2 = 1).
Test routine no. 28	Mobile TX power
Power level:	0 to 7. (See under 'General AMPS system information'.)
Upper limit:	+2 dB.
Lower limit:	-4 dB.
Test routine no. 29	Bit error rate.
Lower limit:	95% of audit orders confirmed by mobile.
RF generator level:	-113 dBm.
Test routine no. 30	DTMF tones
Summary line:	Scroll (if disabled).
Test routine no. 31	Hook flash
Summary line:	Scroll (if disabled).
Test routine no. 32	Data deviation
Nominal deviation:	8 kHz.
Maximum error:	10%.

Test routine no. 33	ST deviation
Nominal deviation:	8 kHz.
Maximum error:	10%.
Test routine no. 34	ST duration
Nominal duration:	Dependent on preceding tests. 50 ms for Handoff. 400 ms for Hook flash. 1.8 s for a Clear down.
Maximum error:	10%.

Manual test operation

Channel selection:	0 to 1023. (Channels 800 to 990 are mapped below channel 991.)
SAT frequency setting:	3 to 8 kHz. (Hardware resolution 5 Hz.)
SAT level:	0 to 2.5 kHz. (Hardware resolution nominally 12 Hz.)
Data level:	0 to 10 kHz. (Hardware resolution nominally 40 Hz.)
Non-conversation operating modes:	DATA OFF (SAT measurement enabled), SIGNAL TONE (10 kHz), DOTTING (5 kHz), FCC, REGISTRATION, PAGE MOBILE, PLACE CALL, DIRECTED RETRY and NEW ACCESS CH.
Conversation operating modes:	CONVERSATION (SAT measurement enabled), HANDOFF, POWER LEVEL and CLEAR DOWN.
Audio paths for use with 2955 mode:	RX (AF input), RX x20 (AF input amplified with a gain of 20) and TX (demodulated signal from Adapter).
SAT measurement:	SAT deviation is measured while SAT is being displayed. Otherwise, the reading is frozen. Update rate is every 6 seconds if DC voltage is >1 V. Otherwise, it is every 2 seconds.
ST indication:	When a signalling tone is being received, ST is displayed.
DTMF tones:	Up to 10 tones are displayed. More than 10 causes the display to scroll.
DC power:	DC voltage, current and calculated power indicated if >1 V.

User controls	Four mode keys as below.
2955:	Selects normal 2955 operation.
CRTS:	Selects cellular (and trunked) radio test system mode.
DISC:	Selects disc menu.
PSOPH:	Selects psophometric filter. Selects local when in remote.
DC power supply meter	
Voltage range:	1 to 25 V.
Voltage accuracy:	±5% ±100 mV.
Current range:	0 to 10 A.
Current accuracy:	±5% ±200 mA.
Power accuracy:	±10% ±20 mW, 100 mW to 200 W.
AF input to AF output	As 2955 except AC coupling only and x20 amplifier for <100 mV.
External modulation input	0.5 V pk-pk for 5 kHz deviation ±10% at 1 kHz.
AF measurement de-emphasis	6 dB/octave, 300 Hz to 3.4 kHz.
Psophometric (CCITT) filter	CCITT filter selectable for psophometric audio measurements.
Frequency response:	Conforms to CCITT Recommendation P53.
Tolerances:	50 to 300 Hz ±2 dB. 300 to 800 Hz ±1 dB. 800 Hz reference 0 dB. 800 Hz to 3 kHz ±1 dB. 3 to 3.5 kHz ±2 dB. 3.5 to 5 kHz ±3 dB.

Psophometric (C-message) filter

C-message filter selectable for psophometric audio measurements.

Frequency response:

Relative to 1 kHz reference.

60 Hz	55.7 ±2 dB.
100 Hz	42.5 ±2 dB.
200 Hz	25.0 ±2 dB.
300 Hz	16.5 ±1 dB.
400 Hz	11.4 ±1 dB.
500 Hz	7.5 ±1 dB.
600 Hz	4.7 ±1 dB.
700 Hz	2.7 ±1 dB.
800 Hz	1.5 ±1 dB.
900 Hz	0.6 ±1 dB.
1 kHz	0.0 dB reference.
1.2 kHz	0.2 ±1 dB.
1.3 kHz	0.5 ±1 dB.
1.5 kHz	1.0 ±1 dB.
1.8 kHz	1.3 ±1 dB.
2 kHz	1.3 ±1 dB.
2.5 kHz	1.4 ±1 dB.
2.8 kHz	1.9 ±1 dB.
3 kHz	2.5 ±1 dB.
3.3 kHz	5.2 ±2 dB.
3.5 kHz	7.6 ±2 dB.
4 kHz	14.5 ±3 dB.
4.5 kHz	21.5 ±3 dB.
5 kHz	28.5 ±3 dB.

Thereafter, attenuation to increase at 12 dB/octave until it reaches 60 dB.

SAT generation

Frequency range: 3 kHz to 8 kHz in 5 Hz steps, normally 4 kHz or 6 kHz.

Frequency accuracy: Crystal derived, better than ±1 Hz.

Output level accuracy: ±10%, 300 Hz to 2.5 kHz at system frequencies, i.e. 3.955 to 4.045 kHz and 5.970 to 6.030 kHz.

Distortion:
<3%.
<2% at 4 kHz ±45 Hz.
<2% at 6 kHz ±30 Hz.

SAT measurement

Accuracy: ±10% at nominal system SAT frequencies and levels.

ST measurement

Measurement accuracy: ±10% at 5 to 10 kHz.

Tone duration: ±10 ms at 40 ms to 5 s.

FSK data	Manchester encoded NRZ.
Generated data deviation:	±10% at 1 kHz to 10 kHz.
Bit rate:	±1 bit/s (8 kHz, 10 kHz).
Measurement deviation:	±10% at 1 kHz to 10 kHz.
DTMF tone generation	
Frequency accuracy:	±1 Hz at DTMF frequencies.
Deviation:	±10% for 1 to 5 kHz high tone. Low tone equal to high tone ±2 dB.
Distortion:	<3% (individual tones).
Printers	
Printer interfaces:	RS-232, GPIB and Centronics.
Print menu facilities:	Print on PASS, FAIL, ALWAYS.
Control interfaces	
GPIB:	IEEE488 subset SH1, AH1, T5, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.
RS-232:	All standard rates 75 to 9600 baud. Length/parity 8 even, odd, none; 7 even, odd, none. Stop bits 1,2.
Parallel:	Parallel printer (Centronics type). 8-way bi-directional port. 48 mA sink. 4 TTL outputs (unprotected). 4 TTL inputs (unprotected) +5 V DC supply at 100 mA accessory power (unprotected). 3 analogue inputs routed to AF INPUT of 2955, maximum 10 V peak, impedance >1 MΩ (accessible through GPIB).
Disc interface	
Format:	Compatible with 3.5 or 5.25 inch, 40 or 80 track, single-sided or double-sided, single density disc drive with industry standard S.400 (Shugart) controller drive interface. Track to track step time selectable from 6, 12, 20 and 30 ms.
Connector:	34-way IDC male socket.

Power requirements, AC	
Rated supply voltage:	115 V or 230 V nominal AC.
Supply voltage range:	95 to 130 V or 190 to 264 V AC.
Supply frequency range:	50 to 400 Hz ±10%.
Consumption:	30 VA.
Power requirements, DC	Applicable to instruments with serial number prefix 131972 or over. The 2957A has been improved to enable it to have an AC or DC supply. The DC supply is connected to the DC power meter input terminals.
Supply voltage:	±11 to 32 V.
Consumption:	30 W maximum.
Dimensions and Weight	
Height:	231 mm (9.1 in)
Width:	345 mm (13.6 in)
Depth:	490 mm (19.3 in)
Weight:	20.0 kg (44 lb)
Safety:	Complies with IEC 348 safety requirements.
Limit range of operation:	0 to 55°C.
Rated range of use:	0 to 50°C.
Conditions of storage and transport	
Temperature:	-40°C to +70°C.
Humidity:	Up to 90% RH.
Altitude:	Up to 2500 m (pressurized freight at 27 kPa differential (3.9 lbf/ in²).
Radio frequency interference:	Conforms to the requirements of EEC Directive 76/889 as to limits of RF interference.

ACCESSORIES

Supplied	Part no.
Operating Manual (H 52957-901B Vol. 1)	46881-980X
Programming Manual (H 52957-901B Vol. 1A)	46881-981M
Fixing kit	46883-879M
Stowage cover assembly	41690-495E

Optional	
Service Manual (H 52957-901B Vol. 2)	46881-982C
Primary pack	37136-582V
DC supply cable kit	46883-907V
Cable assembly, N to TNC	43130-596E
Cable assembly, parallel control port to Centronics	43130-592K
Cable assembly, serial port to standard RS-232	43130-593A

Chapter 2

INSTALLATION

UNPACKING AND REPACKING

Retain the container, packing material and the packing instructions note (if included) in case it is necessary to reship the instrument.

If the instrument is to be returned for servicing, attach a label indicating the service required, type or model number (on rear label), serial number and your return address. Pack the instrument in accordance with the more detailed information which is given in the packing instruction note or as follows:-

(1) Place the mains lead in a suitable plastic bag and tape it to the instrument rear panel.

(2) Place the instrument within its plastic cover.

(3) Ensure that the padded fitting is in place within the inner carton and slide the instrument in, rear panel first, leaving the front panel exposed at the open end.

(4) Fit the separate front panel protecting cover over the panel and close and seal the inner carton.

(5) Place one of the moulded plastic cushions in the bottom of the outer carton and insert the inner carton so that it locates in the cushion recess.

(6) Place the remaining plastic cushion over the other end of the inner carton and close and seal the outer carton.

(7) Wrap the container in waterproof paper and secure with adhesive tape.

(8) Mark the package FRAGILE to encourage careful handling.

Note...

If the original container or materials are not available, use a strong double-wall carton packed with a 7 to 10 cm layer of shock-absorbing material around all sides of the instrument to hold it firmly. Protect the front panel controls with a plywood or cardboard load spreader.

MOUNTING ARRANGEMENTS

Excessive temperatures may affect the instrument's performance. Avoid standing the instrument on or close to other equipment that is hot.

TEST SET INTERCONNECTIONS

If the instrument received is a complete Radio Test System 2957A, it only requires connection to the power supply and the peripherals to be fully operational.

Note...

On the 2955's GPIB interface unit, check that the 2 and 4 switches are set on (not OPEN) to give an address of 6 (or any other address in the range 1 to 30) and that the TALK ONLY switch is set to OPEN. See Fig. 2-3.

If the instrument received is a Cellular Adapter for converting an existing Radio Communications Test Set 2955 to a Radio Test System 2957A, follow the procedure below. First, make sure that the 2955 is fitted with a GPIB interface unit.

Converting a 2955 to a 2957A

The 2957A consists of a Cellular Adapter and a 2955 which are assembled together. See Fig. 2-1 and Fig. 2-2. Proceed as follows:-

(1) Unpack the Cellular Adapter and check that the accompanying Fixing Kit 46883-879M contains the items given in Table 2-1. If any part is missing, contact your nearest Marconi Instruments representative. (For the address, see the rear cover).

(2) Turn the 2955 upside down and lever off the caps covering the screws which hold the feet in place. Save the caps.

(3) Unscrew and remove the 4 feet. Save the screws.

(4) Insert the 4 clips (items 5 and 6) in the slots in the positions formerly occupied by the feet. The clips are handed. Lay them flat and positioned so that the screw holes in the clips line up with the screw holes in the 2955's bottom cover.

(5) In place of the 4 feet, screw in the 4 pillar assemblies (item 4).

TABLE 2-1 FIXING KIT CONTENTS

Item	Description	Part no.	Quantity
1	Cable assembly, BNC connectors, 0.13 m	43130-498L	2
2	Cable assembly, BNC connectors, 0.26 m	43130-499J	1
3	Mains cable assembly	43137-364J	1
4	Pillar assembly	41700-616V	4
5	Clip (right-hand)	35905-447D	2
6	Clip (left-hand)	35905-448T	2
7	Rear support bar	41700-639Y	2
8	Screw pan head M4 x 8	21837-459D	2
9	Screw pan head M4 x 12	21837-463T	2
10	Crinkle washer M4	21177-650H	4

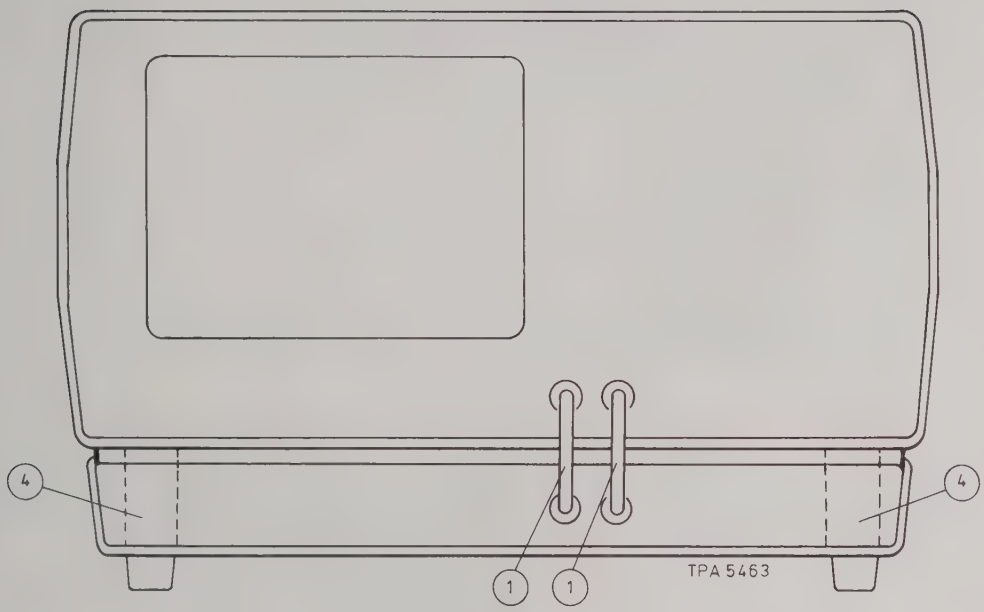


Fig. 2-1 Front view showing electrical and mechanical connections (item numbers as given in Table 2-1)

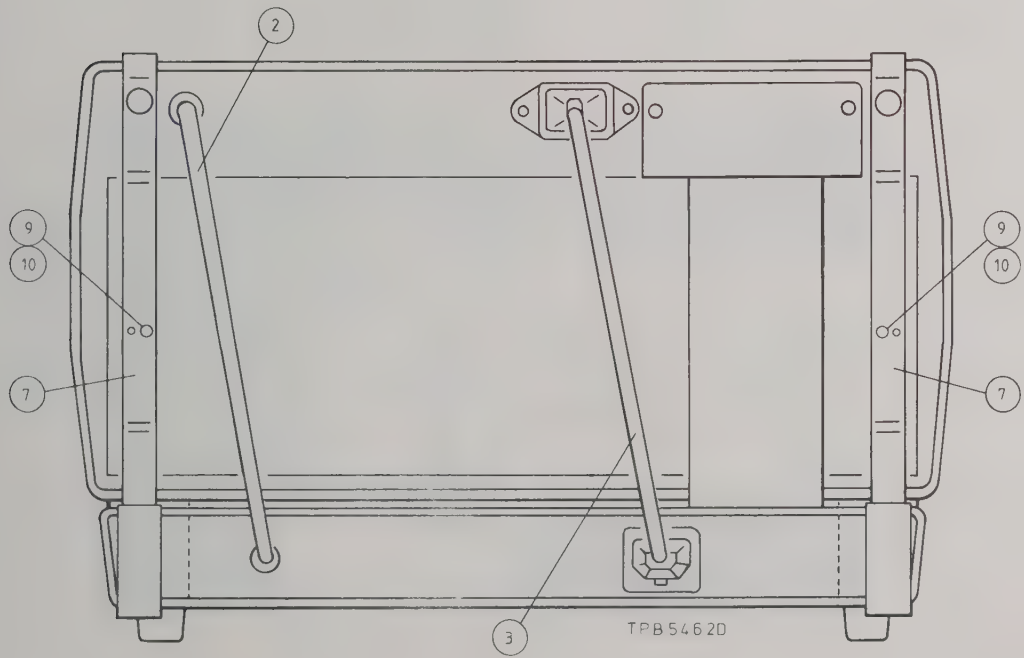


Fig. 2-2 Rear view showing electrical and mechanical connections (item numbers as given in Table 2-1)

(6) With the 2955 upside down, position the Adapter, also upside down, over it so that the pillars on the 2955 enter the 4 cutouts in the Adapter without trapping any of the cables. At this point, both instruments should line up all the way round.

(7) Screw the 4 feet into the ends of the pillar assemblies.

(8) Replace the caps.

(9) On the 2955, remove the 2 screws which retain the rear cover. Discard the screws.

(10) Hook the curved ends of the 2 rear support bars into the slots in the 2955's upper 2 rear feet.

(11) Screw the other ends of the bars into the Adapter's rear casting using the 2 shorter M4 screws (item 8) with washers (item 10).

(12) Insert the 2 longer screws (item 9) with washers (item 10) through the rear support bars (using the inside holes) into the rear cover screw holes.

(13) Finally, check that both instruments are securely held together. This completes the mechanical connection.

(14) Connect the Adapter's MOD OUT socket to the 2955's EXT MOD INPUT socket using one of the 0.13 m coaxial cable assemblies (item 1).

(15) Connect the Adapter's AF OUT socket to the 2955's AF INPUT socket using the second of the 0.13 m coaxial cable assemblies (item 1).

(16) Connect the Adapter's IF IN socket to the 2955's IF OUT socket using the 0.26 m coaxial cable assembly (item 2).

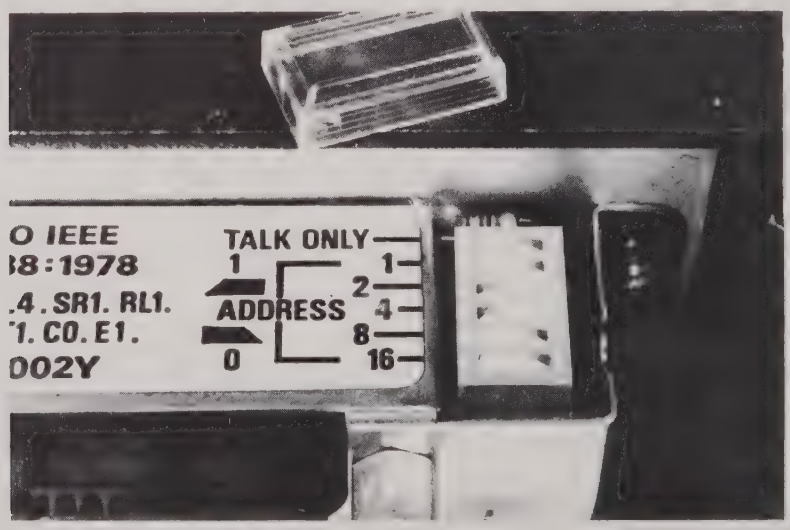


Fig. 2-3 Switches on the 2955's GPIB interface unit set to address 6 (2 + 4) and not to TALK ONLY

(17) Connect the Adapter's AC SUPPLY OUT socket to the 2955's AC SUPPLY socket using the mains cable assembly (item 3).

(18) Connect the Adapter's internal GPIB ribbon cable to the 2955's GPIB connector and fasten it using the lock screws provided.

(19) On the 2955's GPIB interface unit, set the 2 and 4 switches to on (not OPEN) to give an address of 6 (or set any other address in the range 1 to 30). Set the TALK ONLY switch to OPEN. See Fig. 2-3.

(20) Finally, switch both the Adapter and the 2955 on after ensuring that both voltage selectors are set to the correct range with correct fuses fitted. Check that the GPIB address is correct. Press the CRTS key and check that the self test sequence commences.

SAFETY TESTING

Where safety tests on the AC supply input circuit are required, the procedures below can be applied. These comply with BS4743 and IEC348. Tests are to be carried out as follows and in the order given, under ambient conditions, to ensure that AC supply input circuit components and wiring (including earthing) are safe:-

(1) **Earth lead continuity test** From any part of the metal frame to the bared end of the flexible lead for the earth pin of the user's AC supply plug. Preferably a heavy current (about 25 A) should be applied for not more than 5 seconds. The test limit is not greater than 0.5 Ω.

(2) **500 V DC insulation test** From the AC supply circuit to earth. The test limit is not less than 2 MΩ.

AC POWER SUPPLY REQUIREMENTS

Each of the two instruments comprising a 2957A, the 2955 and the Adapter, requires 105 to 120 V or 210 to 240 V AC, 50 to 400 Hz. For the Adapter, the required supply fuses (time lag) are 500 mA for 105 to 120 V or 250 mA for 210 to 240 V. Before switching on, ensure that the rear panel voltage range switches are in their correct positions as revealed by the cut-outs in the locking plates and that the correct value fuses are fitted. To change a mains voltage setting, reverse the locking plate after setting the slide switch to its alternative position. Ensure that the Adapter and the 2955 are both set to the same voltage range and that the mains cable assembly is fitted between the Adapter's AC SUPPLY OUT and the 2955's AC SUPPLY connectors.

The mains cable assembly is fitted at one end with a female plug which mates with the AC connector at the rear of the Adapter. When fitting a supply plug, ensure that the connections are as follows:-

Earth (ground)	- Green and yellow
Neutral	- Blue
Live (phase)	- Brown

When attaching the mains cable to a non-soldered plug, it is recommended that the tinned ends of the lead are first cut off to avoid the danger of cold flow resulting in intermittent connection.

DC POWER SUPPLY REQUIREMENTS

Applicable to instruments with serial number prefix 131972 or over.

Connect ±11 to 32 V to the left-hand red (live) and black (chassis) terminals on the rear.

GENERAL PURPOSE INTERFACE BUS

Internal GPIB connection

The 2957A only operates with the internal GPIB cable connected between the Adapter and the 2955 GPIB connector. See Fig. 2-3.

External GPIB connection

Connection to other equipment is made using the Adapter's rear panel IEEE488 24-way connector. For this purpose, a GPIB cable assembly is available as an optional accessory. An optional IEEE-to-IEC adapter is available for connecting to systems which use a 25-way bus connector to IEC Recommendation 625. See Fig. 2-4.

GPIB connector contacts

The contacts on the GPIB cable connector and the device connector are as shown in Fig. 2-5.

The cables have male-female connectors at both ends. This allows several connectors to be stacked one on top of another and secured by a lockscrew mechanism. However, there might be damage with too large a stack. The stacking arrangement permits star or linear interconnection between the devices forming a system with the restriction that the total cable length for the system is not greater than 20 m (65 ft) and also not greater than 2 m (6 ft) times the total number of devices (including the controller) connected to the bus.

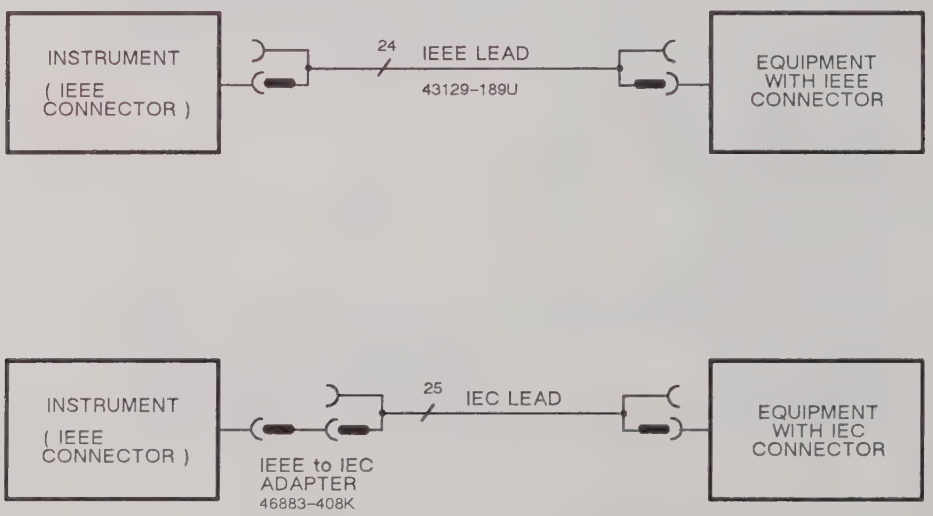


Fig. 2-4 GPIB interconnections

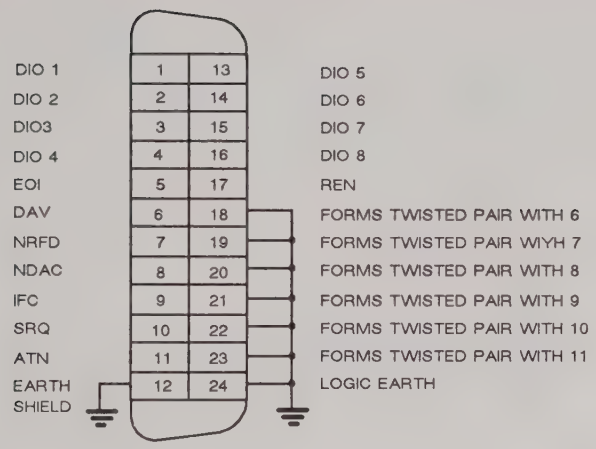


Fig. 2-5 GPIB connector contacts

SERIAL PORT

The contacts of the serial port 15-way connector are shown in Fig. 2-6. Contact functions are given in Table 2-2.

Fig. 2-6 Serial port connector contacts
(as viewed from the side of the instrument)

TABLE 2-2 SERIAL PORT CONNECTOR CONTACTS

Contact	Function	Contact	Function
1	Rx data, TTL	9	RTS, RS-232
2	Earth	10	Earth
3	Rx data, RS-232	11	RTS, TTL
4	Earth	12	Earth
5	Tx data, TTL	13	CTS, RS-232
6	Earth	14	+5 V out
7	Tx data, RS-232	15	CTS, TTL
8	Earth		

A serial port to standard RS-232 cable assembly, available as an optional accesssory, is shown in Fig. 2-7.

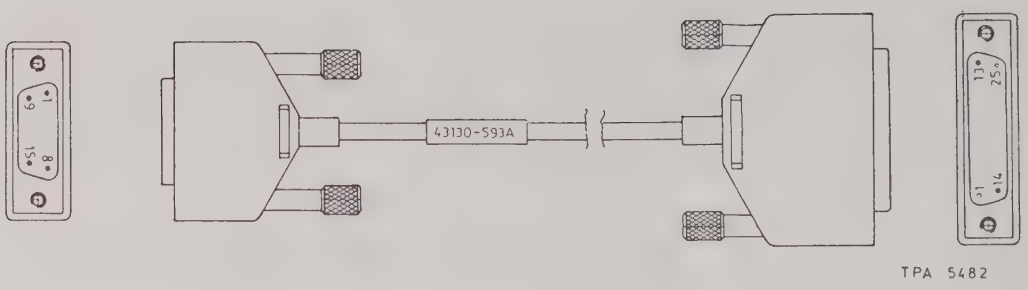


Fig. 2-7 Serial port to standard RS-232 cable connector contacts (looking into the connectors)

PARALLEL CONTROL PORT

The contacts of the parallel control port 37-way connector are shown in Fig. 2-8. The functions of the contacts are given in Table 2-3.

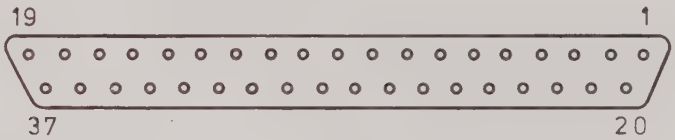


Fig. 2-8 Parallel control port connector contacts (as viewed from the front of the instrument)

TABLE 2-3 PARALLEL CONTROL PORT CONNECTOR CONTACTS

Contact	Function	Contact	Function
1	+5 V out	20	Earth
2	Latch in 2	21	Latch in 1
3	Latch in 4	22	Latch in 3
4	Modulator input	23	RSSI input
5	I/O control strobe L	24	Discriminator input
6	Data 7	25	Data 8
7	Latch out 2	26	Data 6
8	Latch out 3	27	Earth
9	Data 5	28	Latch out 1
10	Data 3	29	Data 4
11	Data 1	30	Data 2
12	I/O control ACK L	31	I/O control
13	Latch out 4	32	I/O control
14	Earth	33	Earth
15	Earth	34	Earth
16	Voltmeter input	35	Voltmeter input
17	Not connected	36	Not connected
18	Not connected	37	Not connected
19	Not connected		

A parallel control port to Centronics cable assembly, available as an optional accessory, is shown in Fig. 2-9. The contacts for the D-type connector to the 2957A and the type 57 connector to the printer are shown in Fig. 2-9. The functions of the contacts are shown in Table 2-4.

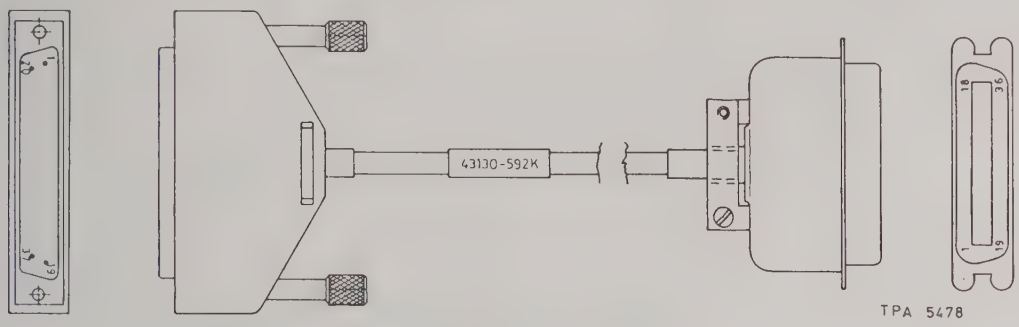


Fig. 2-9 Parallel control port to Centronics cable connector contacts (looking into the connector)

TABLE 2-4 PARALLEL CONTROL PORT TO CENTRONICS CABLE CONNECTOR CONTACTS

D type connector contact (2957A)	Printer function	Type 57 connector contact (printer)
5	Strobe L	1
6	Data 7	8
9	Data 5	6
10	Data 3	4
11	Data 1	2
12	ACK L	10
14	Earth	19 and 26
15	Earth	22 and 23
25	Data 8	9
26	Data 6	7
27	Chassis	17
29	Data 4	5
30	Data 2	3
33	Earth	20 and 21
34	Earth	24 and 25

DISC INTERFACE PORT

The contacts of the disc interface 34-way connector are shown in Fig. 2-10. When a non-polarized connector is used, ensure that contact 1 (arrow marking and/or stripe on cable) is to the front. Contact functions are given in Table 2-5.

Fig. 2-10 Disc interface connector contacts
(as viewed from the side of the instrument)

TABLE 2-5 DISC INTERFACE CONNECTOR CONTACTS

Contact	Function	Contact	Function
1	Unused	2	Unused
3	Unused	4	Unused
5	Unused	6	Unused
7	Earth	8	Index
9	Earth	10	DS0
11	Earth	12	DS1
13	Unused	14	Unused
15	Earth	16	Motor on
17	Earth	18	Direction
19	Earth	20	Step
21	Earth	22	Write data
23	Earth	24	Write gate
25	Earth	26	Track 00
27	Earth	28	Write protect
29	Earth	30	Read data
31	Earth	32	Side select
33	Unused	34	Unused

Chapter 3-0

INTRODUCTION TO OPERATION

CHAPTERS

As the 2957A is so versatile, operation is covered in three chapters as follows:-

(a) Chapter 3-0. This introductory chapter.

(b) Chapter 3-1. This covers local operation by using the controls on the 2955 and on the Adapter.

(c) Chapter 3-2. This covers remote control using the GPIB interface port or the RS-232 serial interface port.

The Programming Manual covers programming for remote control and to enable the user to define his own test sequences and to define parameters in test routines for local control.

INTERCONNECTIONS

Start by connecting the radio under test to the 2957A as described on page 3-1-11.

STARTING

When you switch on, the normal **RECEIVER TEST** display (Fig. 3-2) appears. Press the CRTS key on the Adapter. Initializing and self testing take place as shown on the display (Fig. 3-3). When this is completed, the main top level menu (Fig. 3-4) appears.

Press the FULL AUTO TEST key. The FULL AUTO TEST intermediate display (Fig. 3-6) appears. If the parameters which are shown on this display exactly match the needs of your radio, you can carry on by pressing the START TEST key.

These top level menus and options are summarized in Table 3-1.

CHANGING FORMAT

If the system parameters do not match the radio under test, press the CHANGE FORMAT soft key. The **CHANGE FORMAT MENU** (Fig. 3-7) appears. This leads you to a series of menus so that you can alter any of these parameters. These menus are summarized in Table 3-2.

For full details, see pages 3-1-18 to 3-1-30.

TABLE 3-1 TOP LEVEL MENUS AND OPTIONS FOR AMPS

Menu	Option	Menu	Option	Page
Main				3-1-16
	GO/NO-GO TEST			3-1-31
	FULL AUTO TEST	Intermediate		3-1-18
			START TEST	3-1-32
			CHANGE FORMAT	3-1-18
	MANUAL TEST			3-1-37

FULL AUTO TEST

When you start this test, the 2957A automatically performs the test routines which make up a test sequence. The test sequence is built-in or user-defined and is selected from the **CHANGE FORMAT MENU**.

For full details, see pages 3-1-3 and 3-1-33.

GO/NO-GO TEST

This is similar to the FULL AUTO TEST but it provides only summarized results for each test routine.

For full details, see page 3-1-31.

MANUAL TEST

When you select this mode, you are given the choice of a number of manual tests which can be made. This is useful for trouble-shooting and fault-finding.

For full details, see pages 3-1-37 to 3-1-40.

TEST SEQUENCES

The FULL AUTO TEST and the GO/NO-GO TEST consist of a number of test routines which are combined into built-in or user-defined test sequences.

For full details, see pages 3-1-40 to 3-1-42.

TEST ROUTINES

Each test routine is carried out automatically. There is a choice of eighteen test routines which are combined in the four built-in test sequences and which are available for user-defined test sequences.

For full details, see pages 3-1-43 to 3-1-56.

TABLE 3-2 CHANGE FORMAT MENUS FOR AMPS

Menu	Option	Page
SYSTEM PARAMETERS		3-1-19
	AREA ID	3-1-20
	CONTROL CHANNEL	3-1-20
	VOICE CHANNEL	3-1-20
	HANDOFF INCREMENT	3-1-20
	SAT FREQUENCY	3-1-20
	DCC	3-1-20
MOBILE PARAMETERS		3-1-21
	MOBILE NUMBER	3-1-21
DISPLAY FORMAT		3-1-21
	DISPLAY FORMAT	3-1-22
	PAUSE	3-1-22
	NUMBER FORMAT	3-1-22
TEST SEQUENCE		3-1-23
	BRIEF TESTING	3-1-41
	COMPREHENSIVE TESTING	3-1-42
	CALL PROCESSING ONLY	3-1-40
	CALL AND RF TESTING	3-1-41
	User-defined test sequence	
	DTMF	3-1-23
	HOOK FLASH	3-1-23
PRINTER		3-1-24
	PRINTER PORT	3-1-24
	PRINT	3-1-24
	TERMINATE	3-1-24
INTERFACE		3-1-25
	BAUD RATE	3-1-26
	LENGTH/PARITY	3-1-26
	STOP BITS	3-1-26
	GPIB ADDRESS	3-1-26
MISCELLANEOUS		3-1-26
	DE-MOD SOURCE	3-1-27
	DISC STEP RATE	3-1-27
	PRINTER PORT COMMAND	3-1-27
	SYSTEM CONFIGURATION	3-1-27
EDIT COMMAND		3-1-28
SYSTEM PARAMETER WORD 2		3-1-29

Chapter 3-1

OPERATION

INTRODUCTION

The 2957A is a combined instrument which consists of a Radio Communications Test Set 2955 series and a Cellular Adapter.

As this chapter describes the operation of Radio Test System 2957A, the operation of the 2955 is not explained except where pertinent. Full details of 2955 operation are given in the Operating Manual for the 2955.

INDICATORS, CONTROLS AND CONNECTORS

2957A front panel

See Fig. 3-1.

(1) SUPPLY switches. When both switches are set to ON, power is supplied through the rear panel AC SUPPLY IN connector (21) to the Adapter, and from the AC SUPPLY OUT connector (22) through the AC SUPPLY connector (26) to the 2955. Note that the Adapter's SUPPLY switch does not control power to the AC SUPPLY OUT connector as it is wired directly to the AC SUPPLY IN connector.

(2) 2955 MODE key. Selects the normal mode of operation of the 2955. During this mode, the Adapter is mainly passive. When 2955 mode is selected and the Adapter is in conversation mode and sending or generating data, the CRTS indicator LED remains on. This is to remind the user that modulation generated by the 2955 is combined with these signals. To disable these signals, press the 2955 key again. If the 2955 mode is selected when the system is in remote, on the GPIB or the RS-232 interface, any modulating signals are removed immediately to ensure a fast flow of data through the Adapter.

(3) CRTS MODE key. Selects the Radio Test System mode of operation with the Adapter controlling the 2955. When this key is first pressed after power-on, the instrument commences its self-test and calibration sequence. This is omitted on subsequent key presses. When this key is pressed immediately following 2955 operation, the 2957A returns to the menu previously selected (if permissible). It can also be used to abort a particular test sequence and to return to the top level menu at any time.

(4) DISC MODE key. Selects a menu which permits user-defined sequences to be loaded and saved using an accessory disc drive. This key is enabled when one of the top level system menus is being displayed.

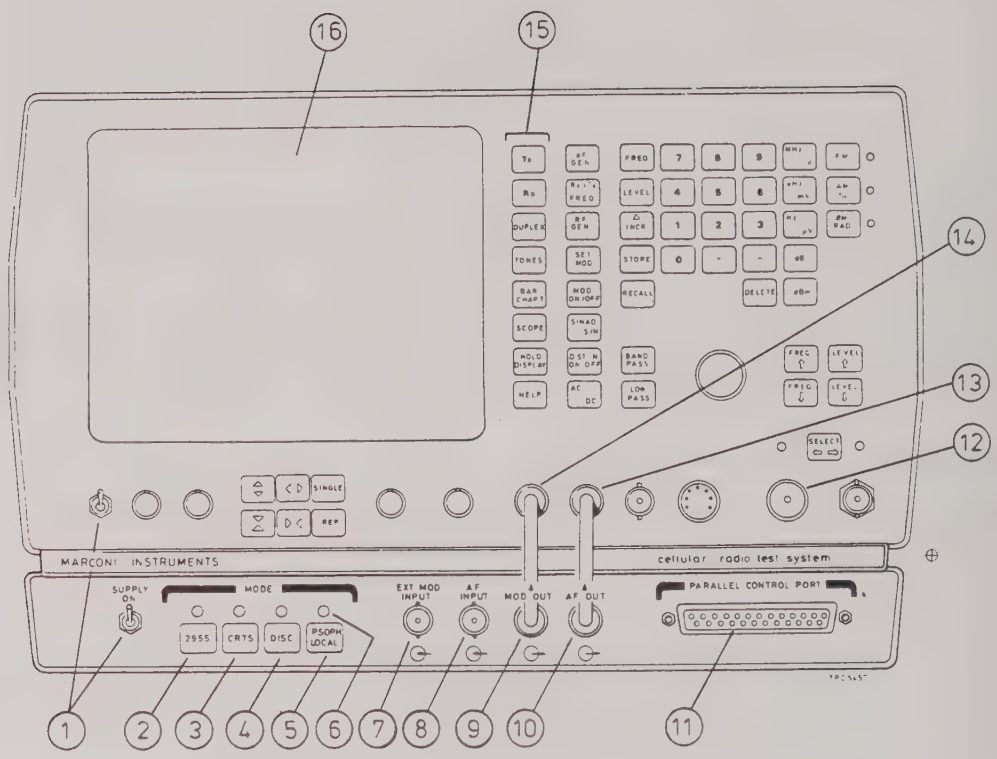


Fig. 3-1 2957A front panel

(5) PSOPH/LOCAL MODE key. The PSOPH key function is only enabled during 2955 local operation. It toggles between removal and insertion of the psophometric filter in the AF input path. When the filter is inserted, the LED above the key is lit. The LOCAL key function is only enabled during remote operation (unless GPIB local lockout asserted). It switches control from remote to local as shown on the display.

(6) MODE key LEDs. These light to indicate that the selected mode is enabled and functioning. One or more LEDs flashing indicates a fault condition as follows:-

LED	Fault
All	Volatile RAM fault.
2955	2955 not responding.
CRTS	ROM fault.
DISC	Non-volatile RAM fault.
PSOPH	System ROM fault.

Flashing of the CRTS, DISC or PSOPH LED can be cancelled by pressing another of the Adapter's MODE keys. If either CRTS or DISC is then pressed and the associated LED flashes, this indicates that the 2955 is not connected or not addressable. Switch the instrument off and on again after the fault has been corrected.

(7) EXT MOD INPUT socket. BNC socket for the application of an external modulation source when this is required for additional tones signalling. Also used for an external demodulated source when selected from the MISCELLANEOUS menu. This enables data signals to be sent to the 2957A's modems without being modulated on a carrier. This is useful for testing logic boards.

(8) AF INPUT socket. BNC socket for audio signals from the mobile. The input is AC coupled.

(9) MOD OUT socket. BNC socket for connection to the 2955's EXT MOD INPUT socket (14). Modulates the 2955 signal generator with serial data and tones.

(10) AF OUT socket. BNC socket for connection to the 2955's AF INPUT socket (13).

(11) PARALLEL CONTROL PORT connector. Used for connection to a Centronics or parallel type printer or for automatic control of mobile interfaces.

(12) RF IN/OUT socket. N socket for the RF input. 50 Ω impedance.

(13) AF INPUT socket. BNC socket for the AF output from the Adapter's AF OUT socket (10).

(14) EXT MOD INPUT socket. BNC socket for the modulating output from the Adapter's MOD OUT socket (9).

(15) Soft keys. When in CRTS mode, these are used as soft keys to select a programmed function. The function is displayed on the screen alongside the activating key.

(16) Display. Used to display the operating menus and test sequences. At times, certain of the hard keys are depicted on the screen. This indicates that these keys may be used.

2957A rear panel

See Fig. 3-2.

(17) DC in/out connectors. Used for making power consumption measurements. The DC supply for the unit under test is connected to the left-hand pair of terminals. The DC output to supply the unit under test is connected to the right-hand pair of terminals. In both cases the upper, red terminal is live (+) and the lower, black terminal is connected to the chassis (-).

(18) IF IN socket. BNC socket for connection from the 2955's IF OUT socket (29).

(19) AC supply voltage selector. To change the Adapter's AC range. The 2955's supply voltage selector (28) has to agree with this setting.

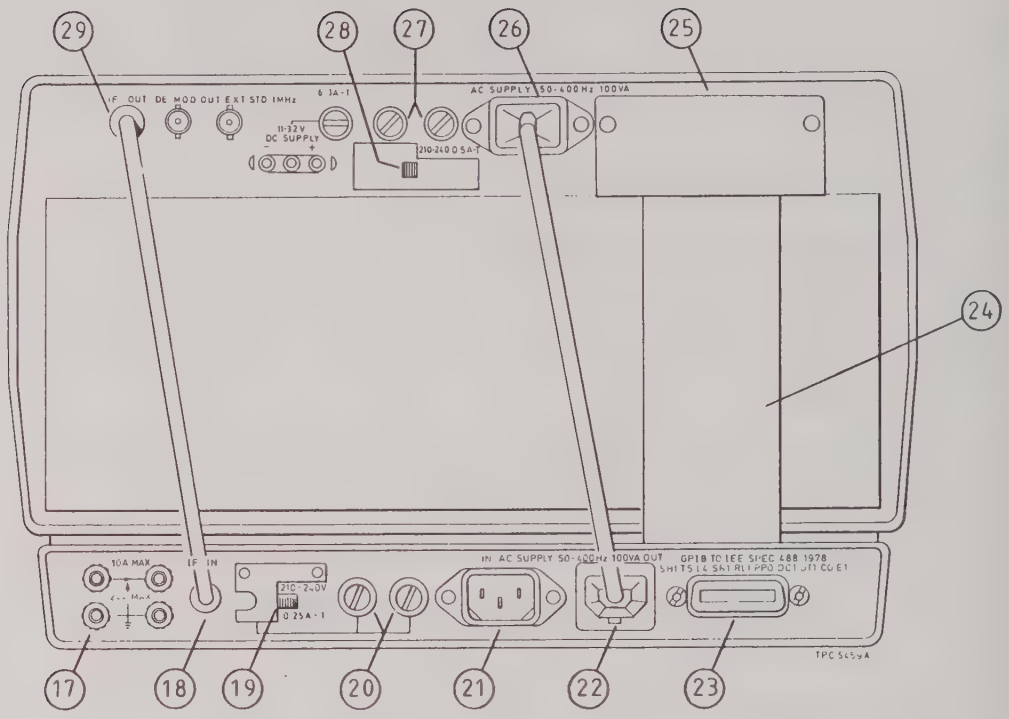


Fig. 3-2 2957A rear panel

(20) AC supply fuses. Time delay cartridge type for fusing the Adapter.

(21) AC SUPPLY IN connector. Supplies both the Adapter fused by (20) and the 2955 through the AC SUPPLY OUT socket (22).

(22) AC SUPPLY OUT connector. Supplies power to the 2955's AC SUPPLY connector (26).

(23) External GPIB connector. Enables the 2957A to be remotely controlled using the IEEE488 (or IEC625 with an adapter) bus. May also be used for the connection of a printer in listen only mode.

(24) Internal GPIB cable and connector. For connection to the 2955's GPIB connector (25).

(25) 2955 GPIB connector. For internal GPIB connector (24) which allows the Adapter to remotely control the 2955 using the IEEE488 bus.

(26) AC SUPPLY connector. Supplied with power from the Adapter's AC SUPPLY OUT connector (22). Fused by (27).

(27) AC supply fuses. Time delay cartridge type for fusing (26).

(28) AC supply voltage selector. To change the range. Has to be set to agree with the setting of the Adapter's supply voltage selector (19).

(29) IF OUT socket. BNC socket supplying a 110 ±10 kHz IF output to the Adapter's IF IN socket (18).

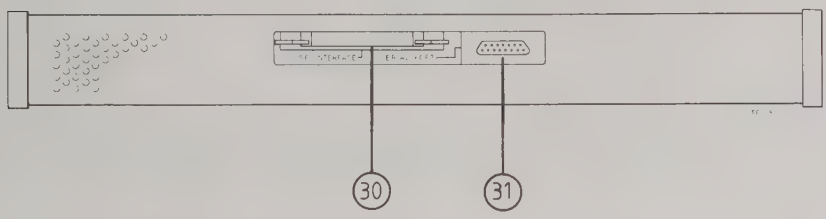


Fig. 3-3 Adapter side panel

Adapter side panel

See Fig. 3-3.

(30) DISC INTERFACE connector. For a floppy disc drive. Enables user-defined tests to be loaded into or saved from the Adapter's non-volatile memory.

(31) SERIAL PORT connector. Enables the 2957A to be remotely controlled from a terminal or computer using the RS-232 interface. May also be used for the connection of a printer with a suitable cable.

DISC OPERATION

A 3.5 or 5.25 inch, 40 or 80 track floppy disc drive can be connected. Single-sided or double-sided discs can be used but only 40 tracks on one side are used. Head stepping times of 6, 12, 20 or 30 ms can be selected; 6 ms is the default setting. These times refer to the inter-track stepping time, not the head settling time. For example, if the drive has a 25 ms step time, the time should be set to the next slower speed, i.e. 30 ms. Most modern drives are 3 or 6 ms.

Preparation

Connect the disc drive to its power supply and switch on. Connect the drive ribbon cable to the DISC INTERFACE connector. For connector compatiblity, see Chap. 2. Insert a disc in the drive slot and close the lock.

Press the DISC key. The **DISC CATALOG MENU** appears as shown in Fig. 3-4. The drive should start up.

If the message DISC FAULT appears, it indicates that the catalogue cannot be read as the disc has not been formatted or is faulty. If the message DRIVE NOT READY is shown, there has been no response from the drive. In either case, remove the disc drive cable, check the connections and supply and then reconnect the drive cable. Press CAT to re-attempt to read the disc catalogue. If DRIVE NOT READY is again shown, there is probably a fault with the disc drive. If NO DISC INSERTED is shown, insert or re-insert the disc and press CAT. If a file which has been recorded under a superseded software issue is loaded, a warning message is shown in reverse field at the bottom of the screen. An attempt to use this file may cause the system to malfunction and should be avoided.

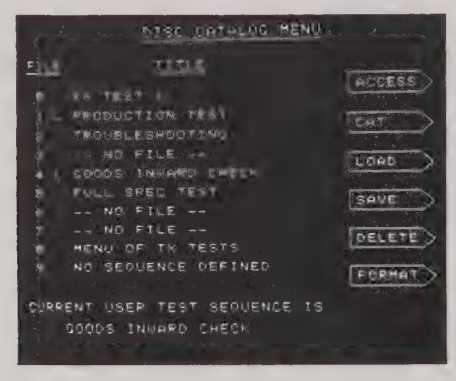


Fig. 3-4 **DISC CATALOG MENU**

The **DISC CATALOG MENU** shows files 0 to 9 together with their titles or NO FILE where appropriate. It shows all the disc functions using the ACCESS, CAT, LOAD, SAVE, DELETE and FORMAT soft keys. When a fault message is shown during operation, refer to 'Fault messages' in Table 3-3.

Formatting

Before a new blank disc can be used, it has to be formatted for the disc filing system. To do this, press the FORMAT key. FORMAT and ENTER flash on the display. As formatting automatically erases all previously saved files, the message DATA ON DISC WILL BE LOST, PRESS ENTER TO CONFIRM is shown. To abort the formatting process, press any other soft key except ENTER. Otherwise, press ENTER to confirm. Formatting takes place and, when completed, the catalogue is updated while CAT flashes.

When CAT stops flashing, NO FILE is shown against all ten files. Discs which have been formatted on 40 track disc drives are not interchangeable with those formatted on 80 track disc drives. On 80 track disc drives, only the first 40 tracks on the disc are formatted.

Saving

To save a file, press the SAVE key. SAVE flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. If a file already exists for that number, the message OVERWRITE EXISTING FILE? PRESS ENTER TO CONFIRM is shown and ENTER flashes. To abort the saving process, press any other soft key except ENTER. Otherwise, press ENTER (which changes to SAVE) to confirm. Saving on disc then takes place and when it is completed, the catalogue is updated while CAT flashes. When CAT stops flashing, the file name or NO SEQUENCE DEFINED is shown against the file number.

Loading

To load a file, press the LOAD key. LOAD flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. Loading to memory then takes place and when completed, LOAD stops flashing.

Deleting

To delete a file, press the DELETE key. DELETE flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. If no file is present under that number, the message FILE DELETED is shown. When a file is present, the message ABOUT TO DELETE FILE, PRESS ENTER TO CONFIRM is shown and ENTER flashes. To abort the deletion process, press any other soft key except ENTER. Otherwise, press ENTER (which changes to DELETE) to confirm. File deletion takes place and, when completed, the catalogue is updated while CAT flashes. When CAT stops flashing, --NO FILE-- is shown against the file number.

Locking

To lock a file to prevent it being overwritten by SAVE or deleted by DELETE or to unlock a previously locked file, press the ACCESS key. ACCESS flashes on the display and the file number is requested. Enter the file number using the keypad or abort by pressing any soft key. The catalogue is then updated while CAT flashes. When CAT stops flashing, the letter L is shown against the file number to indicate that it is now locked or, alternatively, the letter L is removed to show that the file has been restored to its normal unlocked state.

Catalogue

Normally, the catalogue is kept updated but, if the disc is changed, it is necessary to press the CAT key to read the catalogue. This is also necessary after a disc drive fault condition. While the catalogue is being updated, CAT flashes. When CAT stops flashing, the current catalogue is shown.

Fault messages

The fault messages, together with their meanings and suggested remedies, are listed in Table 3-3.

TABLE 3-3 DISC DRIVE FAULT MESSAGES

Fault message	Meaning	Remedy
DRIVE NOT READY	No response from drive	Check disc inserted correctly, check all connections, check power supply, replace faulty drive
NO DISC INSERTED	No disc is present or not correctly inserted in drive or lock not closed	Insert disc correctly and close lock
FILE DELETED	No file present	-
FILE LOCKED	File locked to prevent overwriting	Unlock using ACCESS key
DISC FAULT	(1) Disc not formatted or for different system	Format using FORMAT key
	(2) Discs formatted for 40 and 80 tracks are mixed	Separate different formats
	(3) Verification error (e.g. disc unreliable or dirty head)	Replace disc or clean head
	(4) Faulty drive	Repair or replace drive
	(5) Head misalignment between drives	Try another drive or use one drive for saving and loading
DISC CHANGED	Disc changed since updating of catalogue	Press CAT key for new catalogue
WRITE PROTECTED	Disc physically protected from overwriting	Remove physical protection

OPERATING SUMMARY

The 2957A is used to test a cellular mobile radio by simulating the functions of a cell base station.

Any one of the following test modes can be used:-

(a) GO/NO-GO TEST. See page 3-1-31.
(b) FULL AUTO TEST. See page 3-1-32.
(c) MANUAL TEST. See page 3-1-37.

For the FULL AUTO TEST, the display is in one of the following forms:-

(a) SUMMARY DISPLAY. See page 3-1-31.
(b) FULL DISPLAY. See page 3-1-32.

These are selectable from a menu. With FULL DISPLAY, the top half of the display is the 2955's normal **DUPLEX** test display. The bottom half shows the title, the status and the result of the current test routine. SUMMARY DISPLAY is always selected for the GO/NO-GO TEST mode and it can be selected for the FULL AUTO TEST mode. The SUMMARY DISPLAY shows only the title, the status and the result of the current test routine. Passed test routines scroll up and off the screen; failed test routines remain at the top of the screen.

The 2957A contains four built-in test sequences as follows:-

(a) CALL PROCESSING ONLY. See page 3-1-40.
(b) CALL AND RF TESTING. See page 3-1-41.
(c) BRIEF TESTING. See page 3-1-41.
(d) COMPREHENSIVE TESTING. See page 3-1-42.

Each of the test sequences consists of a number of test routines. Eighteen test routines are available. There are two groups - non-system specific test routines as shown in Table 3-4 and system specific test routines as shown in Table 3-5. The non-system specific test routines are applicable to any cellular radio system but these system specific test routines are applicable only to the AMPS system.

TABLE 3-4 NON-SYSTEM SPECIFIC TEST ROUTINES

Test routine no.	Parameter
1	Transmitter RF power.
2	Transmitter RF frequency.
3	Transmitter AF distortion and SINAD.
4	Transmitter modulation limiting.
5	Transmitter modulation compression.
6	Receiver AF distortion and SINAD.
7	Receiver sensitivity.
8	Receiver demodulation expansion.
9	DC power consumption.
10 to 19	(Not implemented.)

TABLE 3-5 SYSTEM SPECIFIC TEST ROUTINES (AMPS)

Test routine no.	Parameter
20	Registration.
21	Call from cell to mobile.
22	Call from mobile to cell.
23	Handoff.
24	Automatic handoff.
25	SAT transponding.
26	Clearing down from cell.
27	Clearing down from mobile.
28	Mobile TX power.
29	Data performance.
30	DTMF tones.
31	Hook flash.
32	Data deviation.
33	ST deviation.
34	ST duration.
35 to 39	(Not implemented.)

The menus which allow the user to define all the parameters are accessed by selecting FULL AUTO TEST on the top level menu. The succeeding menu gives the option CHANGE FORMAT. Pressing this soft key brings up two pages of **CHANGE FORMAT MENU** which enables the user to change parameters from the following:-

(a) **SYSTEM PARAMETERS MENU.**
(b) **MOBILE PARAMETERS MENU.**
(c) **DISPLAY FORMAT MENU.**
(d) **TEST SEQUENCE MENU.**
(e) **PRINTER MENU.**
(f) **INTERFACE MENU.**
(g) **MISCELLANEOUS MENU.**

Six memories are available for storing six full sets of parameters.

A printer can be connected to the GPIB port (with the printer in listen-only mode), the RS-232 port (serial printer) or to the parallel control port (parallel printer). The printer can print either a summary of the test routines performed or only the passes or failures as they occur.

A disc drive can be connected to the Adapter using the connector on the right-hand side. The drive has to be compatible with the Shugart S.400 interface and may be 3.5 or 5.25 inch, 40 or 80 track. Discs can be single-sided or double-sided although only 40 track on one side are used.

During the FULL AUTO TEST mode, the test sequence can be halted by use of the PAUSE key. A menu is provided to allow the user to define when the selected test sequence should halt. See page 3-1-22. Options available are as follows:-

(a) Pause after each test routine.
(b) Pause by manual use of the PAUSE key.
(c) Pause when failure occurs in a test routine.

INTERCONNECTIONS

For audio tests, it may be necessary for the user to construct an interface unit. The unit has to be compatible with the radio under test and with the 2955's AF output and the Adapter's AF input requirements. The unit is typically connected between the radio's handset and its transceiver unit to provide suitable unbalanced connections from the microphone to the 2955's AF GEN OUTPUT socket and the earphone to the Adapter's AF INPUT socket.

Bearing in mind that the radio and test interface connections are likely to vary between manufacturers, connect the 2957A to the radio under test, as shown in Fig. 3-5, as follows:-

(1) Connect the 2955's RF IN/OUT N socket to the transceiver's antenna connector. This is required for all tests.

(2) Connect the 2955's AF GEN OUTPUT socket and the Adapter's AF INPUT socket to the audio test interface unit. This is required for the BRIEF TESTING and the COMPREHENSIVE TESTING sequences.

(3) Connect the radio's DC power input leads to its DC supply using the Adapter's DC in/out connectors - the radio to the right-hand pair and the supply to the left-hand pair. These connections are only required for measuring the radio's input power in the COMPREHENSIVE TESTING sequence or in the MANUAL TEST mode. Otherwise, the radio can be connected directly to its power supply.

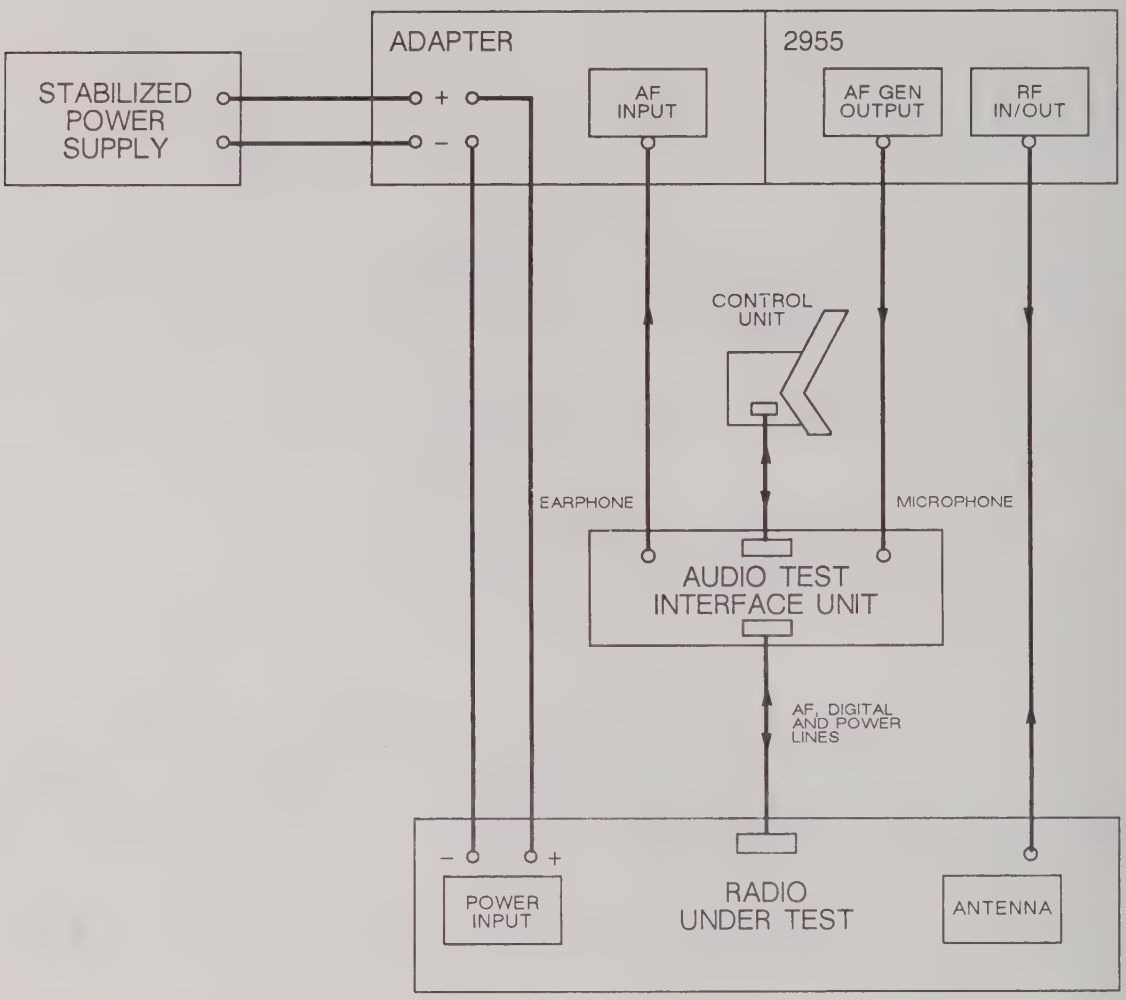


Fig. 3-5 Interconnections

CRTS MODE

Proceed as follows:-

(1) Switch on both the 2955 and the Adapter. (There is no particular order of switching on). All 4 LEDs on the Adapter light and then go out after a pause. The RECEIVER TEST display appears on the screen as shown in Fig. 3-6. The LED lights above the 2955 key on the front panel of the Adapter. If one or more LEDs flash, this indicates a fault condition. (See 'Conditions indicated by LEDs' below.

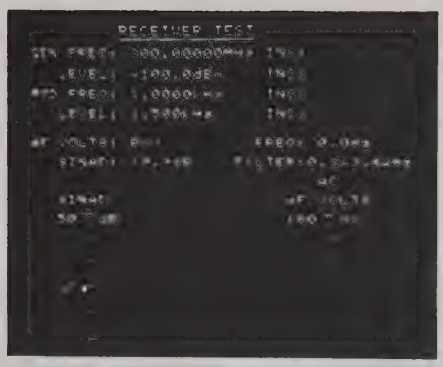


Fig. 3-6 Display following switch-on

(2) Press the CRTS key. The display changes to **AMPS CELLULAR RADIO TEST SYSTEM** as shown in in Fig. 3-7. The 2957A performs a series of self tests which include self calibration. For each self test, a line appears on the display and, if passed, is replaced by the next one. When a failure occurs, the CONTINUE key appears together with an appropriate message.

(3) To retain the display line for a test and subsequent tests, press the TX TEST key during that test. This effect is cancelled when the TX TEST key is pressed again.

Occasionally, the instrument may indicate a failure. This could be caused by a genuine fault or could be due to some other reason. Some examples are as follows:-

(a) An active radio is attached to the 2955 series Test Set during calibration.

(b) One or more link leads is missing, incorrectly fitted or defective.

(c) A signal is applied to the EXT MOD INPUT socket during calibration.

(d) There is a failure during self calibration because of sporadic mistiming.

When there is a failure during self calibration, the instrument assumes default calibration settings. This ensures normal operation of the other areas of the instrument.

Self calibration routines have been optimized for speed based on typical performances of Adapters and 2955 series Test Sets. Occasionally, calibration may not be completed correctly because of noise effects, temperature variation and digital offsets. When a failure is indicated, press the TX TEST key to repeat the self test and calibration. If the repeat is satisfactory, there is no further cause for concern.

If failures occur repeatedly, this would indicate a problem. Contact your service agent for further advice.

At the end of the self tests, part numbers for the Adapter's motherboard and personality board software and the hardware serial number are given. During the self tests, software version numbers are displayed for the motherboard, the personality board and the 2955.

When the self tests are successfully completed, the main top level menu appears on the screen. This menu is the starting point for selecting the various test functions.

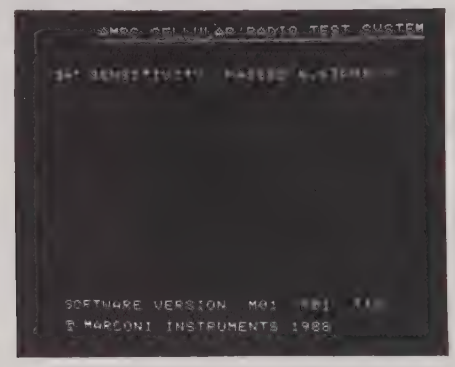


Fig. 3-7 Display following CRTS mode selection

Note...

If the message MEMORY CORRUPTED appears, it means that the settings used when the 2957A was last switched on have been lost. They are replaced by the default settings.

Conditions indicated by LEDs

When one or more of the LEDs on the Adapter flashes, it indicates a failure to successfully enter the required mode or that there is an error condition. The various conditions are summarized in Table 3-6.

TABLE 3-6 LED INDICATIONS

LEDs	Condition	Meaning
All on	At power on	Test function - LEDs should go out after a pause
All flashing	At power on	Volatile RAM failure - instrument cannot continue
2955 flashing	At power on	2955 is not responding on private GPIB - instrument cannot continue until fault is rectified
CRTS flashing	At power on	ROM checksum failure - instrument continues when an Adapter key is pressed if it can
	After power on	CRTS has been selected but 2955 is not responding or is set to talk only mode
DISC flashing	At power on	Non-volatile RAM checksum failure - instrument continues and resets memory to default data when an Adapter key is pressed
	After power on	DISC has been selected but the 2955 is not responding or is set to talk only mode
PSOPH flashing	At power on	System ROM checksum failure - instrument continues when an Adapter key is pressed if it can

Self test failure messages

When a failure occurs during self testing, the appropriate bit in an error byte is set and a message under the relevant heading is displayed. In remote operation, the error byte may be read when self testing is complete by sending RD56 in immediate mode. Messages displayed on the screen are shown in Table 3-7 together with the relevant bit which is set in the error byte and the reason for the failure.

TABLE 3-7 SELF TEST FAILURE MESSAGES

Message	Error byte	Meaning
SAT:UNLOCKED	Bit 0 = 1	>±10 Hz of nominal centre of frequency
SAT:LEVEL	Bit 1 = 1	>20% of FS or >5% of nominal
SAT:DETECTOR	Bit 2 = 1	Not detected off or on
DTMF	Bit 3 = 1	Error in 16 tones.
DATA:REF CLOCK	Bit 4 = 1	>±10 Hz of nominal centre frequency
DATA:LEVEL	Bit 5 = 1	>±20% of FS or >±10% of nominal
DATA:MODEM	Bit 7 = 1	Transmission not received - fault on modem or USART
DATA:CORRUPT	Bit 7 = 1	Data received not same as that transmitted

MAIN TOP LEVEL MENU

An option is selected from a menu by pressing the blue MODE key which is alongside the function shown on the screen. These soft key functions over-ride the normal function of the keys when a menu appears on the screen.

The main top level menu is the menu from which the test modes are selected. See Fig. 3-8. The options are as follows:-

(a) GO/NO-GO TEST. This is a special version of the FULL AUTO TEST mode which provides a quick appraisal of the unit under test. The display format is SUMMARY and the pause is MANUAL ONLY. All other parameters are as specified in FULL AUTO TEST including the test sequence (e.g. COMPREHENSIVE TESTING).

(b) FULL AUTO TEST. This executes a preselected test sequence, either one of the four built-in test sequences or a user-defined test sequence. It is intended for main routine testing. It provides access to the two pages of the CHANGE FORMAT MENU which are used to define the test parameters and instrument settings.

(c) MANUAL TEST. This provides the user with a number of individual call processing tests as well as manual control of the data and SAT generators. It would normally be used for trouble shooting and repair work.

Pressing the CRTS key aborts the current test and returns to the main top level menu.

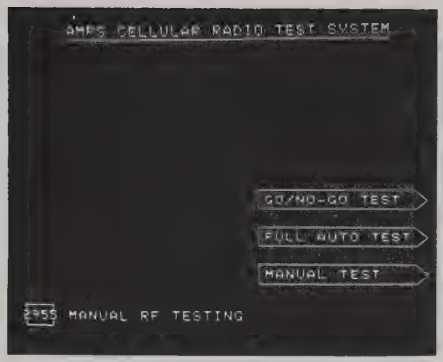


Fig. 3-8 Main top level menu

The 2955 and DISC keys provide the following additional facilities:-

(a) 2955 manual RF testing. Pressing the 2955 key allows the user to manually test the RF and audio stages of a mobile. When the 2955 key is pressed, the 2955's DUPLEX test display appears. The display and the test settings are saved as indicated by the LED above the CRTS key. The normal 2955 operating mode can be accessed by pressing the 2955 key a second time.

(b) Disc facility. Pressing the DISC key allows the user to control a disc drive so that test sequences can be stored and retrieved from a floppy disc without the need for an external controller.

FIRST TIME OPERATION

When the instrument is used for the first time, the test settings have to be defined and selected by means of the **CHANGE FORMAT MENU**. To access this menu, first press the FULL AUTO TEST key. The FULL AUTO TEST intermediate display appears as shown in Fig. 3-9. This shows the main test settings currently selected. It also gives the options of CHANGE FORMAT to select the settings or START TEST to commence testing (once the settings have been defined). Press the CHANGE FORMAT key to obtain the **CHANGE FORMAT MENU**.

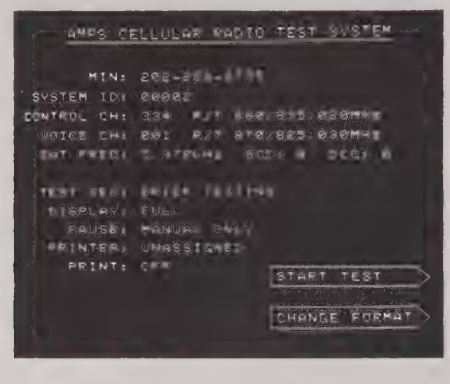


Fig. 3-9 FULL AUTO TEST intermediate display

CHANGE FORMAT MENU

This menu allows the user to define and select test settings before testing is carried out. The current settings are stored in non-volatile memory. This menu is accessed when FULL AUTO TEST is selected from the main top level menu and then CHANGE FORMAT is selected from the FULL AUTO TEST display. The **CHANGE FORMAT MENU** consists of two pages of options to change settings or format display as shown in Fig. 3-10.

Page 1 allows changes to be made under the following options:-

(a) **SYSTEM PARAMETERS MENU**. See page 3-1-19.
(b) **MOBILE PARAMETERS MENU**. See page 3-1-21.
(c) **DISPLAY FORMAT MENU**. See page 3-1-21.
(d) **TEST SEQUENCE MENU**. See page 3-1-23.

Pressing PAGE 2 selects the other page of the menu; RETURN restores the FULL AUTO TEST display.

Page 2 allows changes to be made under the following options:-

(a) **PRINTER MENU**. See page 3-1-24.
(b) **INTERFACE MENU**. See page 3-1-25.
(c) **MISCELLANEOUS MENU**. See page 3-1-26.

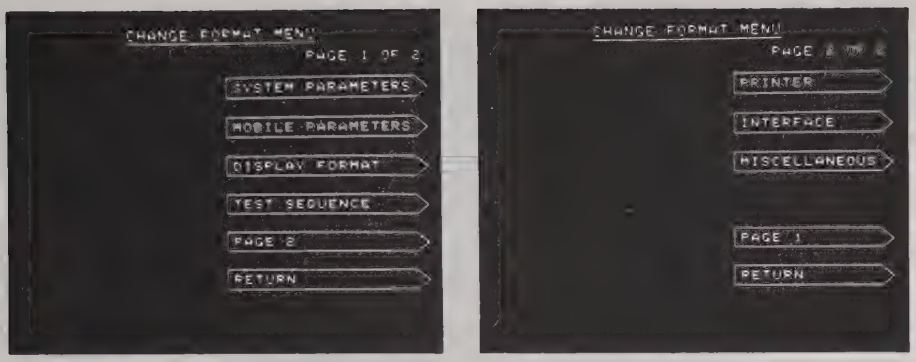


Fig. 3-10 **CHANGE FORMAT MENU** pages 1 and 2

Pressing PAGE 1 selects the other page of the menu; RETURN restores the intermediate menu.

OPTION KEYS

Some of the option keys are marked SELECT and some are marked CHANGE.

A SELECT key has to be pressed repeatedly to scroll through the choices until the required setting is obtained.

A CHANGE key has to be pressed once and then it changes to ENTER. The numerical setting can then be changed by entering a new value on the 2955 keypad. If a mistake is made, press the DELETE key then press the correct key. Any change can be aborted by pressing any other soft key. If the entry is correct, press the ENTER key and then it changes back to CHANGE. If a mistake is now found in the data, the number has to be re-entered after pressing CHANGE.

SYSTEM PARAMETERS MENU

This menu, as shown in Fig. 3-11, allows the user to change parameters under the following options:-

(a) AREA ID.
(b) CONTROL CHANNEL.
(c) VOICE CHANNEL.
(d) HANDOFF INCREMENT.
(e) SAT FREQUENCY.
(f) DCC.

In addition, this menu allows changes to be made under the **SYSTEM PARAMETER WORD 2 MENU** which is not shown in the options. This is selected by pressing the TX TEST key and then, within 2 seconds, pressing the 2 key.

Pressing RETURN restores the **CHANGE FORMAT MENU**.

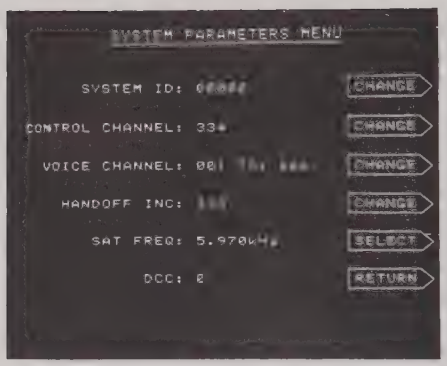


Fig. 3-11 SYSTEM PARAMETERS MENU

AREA ID **setting**

Enter a 5-digit decimal number. The default setting is 00002.

CONTROL CHANNEL **setting**

Enter a number in the range 0 to 1023. The default setting is 333.

VOICE CHANNEL **setting**

For the first voice channel and the last voice channel, enter two numbers in the range 0 to 1023. The default settings are 1 and 666.

The first number is for the initial voice channel that the mobile is to be assigned to when it goes into conversation mode. The second number is for the final voice channel that the mobile is to be assigned to in the test sequences and the automatic handoff test routine (no. 24).

HANDOFF INCREMENT **setting**

Enter a number in the range 1 to 1023. The default setting is 333.

This number is for incrementing between the first voice channel and the last during the automatic handoff test routine (no. 24). Usually 3 or 4 channels are tested.

SAT FREQUENCY **selection**

Select a SAT frequency (5.970, 6.000 or 6.030 kHz) to be generated by the mobile when it enters conversation mode. Repeatedly pressing the SAT FREQUENCY soft key shows the different frequencies in turn in reverse. Stop pressing when the required frequency appears. The default selection is 5.970 kHz.

DCC **selection**

For the digital colour code, select 0, 1, 2 or 3. The default selection is 0.

MOBILE PARAMETERS MENU

This menu, as shown in Fig. 3-12, allows a change to be made under the MOBILE NUMBER option.

Pressing RETURN restores the CHANGE FORMAT MENU.

Fig. 3-12 MOBILE PARAMETERS MENU

MOBILE NUMBER setting

The mobile is identified by a number which has the format xxx-xxx-xxxx. Enter a suitable number. The default setting is 000-000-0000.

DISPLAY FORMAT MENU

This menu, as shown in Fig. 3-13, allows selections to be made under the following options:-

(a) DISPLAY FORMAT.
(b) PAUSE.
(c) NUMBER FORMAT.

Pressing RETURN restores the CHANGE FORMAT MENU.

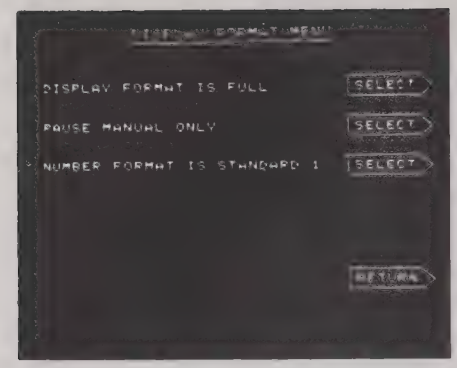


Fig. 3-13 **DISPLAY FORMAT MENU**

DISPLAY FORMAT **selection**

This option selects the display format to be used in the FULL AUTO TEST mode. The choice is between FULL and SUMMARY. FULL format uses a split duplex screen to display the RF and AF parameters of the mobile in the top half with the summary line comprising title, status and result fields together with other information relating to the test routine (e.g. test limits) in the bottom half. SUMMARY format shows a scrolling window of up to 10 summary lines with up to the first 9 failures being retained.

Since it is only intended to provide brief information, the GO/NO-GO TEST mode automatically uses the SUMMARY format.

PAUSE **selection**

This option selects the method of interrupting a test sequence in the FULL AUTO TEST mode from one of the following:-

(a) PAUSE ALWAYS. This causes the test sequence to be halted after each test routine has been completed.

(b) PAUSE MANUAL ONLY. This halts the test sequence only when the PAUSE key is pressed.

(c) PAUSE ON FAILURE. This causes a halt only when a failure has occurred or when the PAUSE key is pressed.

Since it is intended for rapid testing, the GO/NO-GO TEST mode automatically uses PAUSE MANUAL ONLY.

NUMBER FORMAT **selection**

This option selects between DECIMAL, HEXADECIMAL, OCTAL, STANDARD 1 and STANDARD 2 for the mobile's equipment serial number (ESN) which is displayed in the call processing tests. The default setting is STANDARD 1.

When HEXADECIMAL is selected, the number may subsequently be entered in hexadecimal with the letters A to F being entered by using the SCOPE keys. These are reassigned as a letter keypad and depicted on the screen.

TEST SEQUENCE MENU

This menu, as shown in Fig. 3-14, allows selection of the test sequence which is used in the GO/NO-GO TEST and the FULL AUTO TEST modes. Selection is made from the following sequences:-

(a) BRIEF TESTING. See page 3-1-41.
(b) COMPREHENSIVE TESTING. See page 3-1-42.
(c) CALL PROCESSING ONLY. See page 3-1-40.
(d) CALL AND RF TESTING. See page 3-1-41.
(e) Title of a user-defined sequence which is held in the 2957A's non-volatile user memory. NO SEQUENCE DEFINED is displayed as the default title until it is redefined.

BRIEF TESTING is executed by default.

Also, the menu allows selections to be made under the following options:-

(a) DTMF.
(b) HOOK FLASH.

Pressing RETURN restores the CHANGE FORMAT MENU.

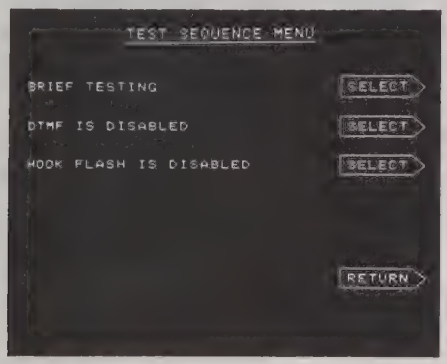


Fig. 3-14 TEST SEQUENCE MENU

DTMF selection

For the DTMF tones test routine (no. 30) in test sequences, selection is made between DISABLED and ENABLED. The default setting is DISABLED.

HOOK FLASH selection

For the hook flash test routine (no. 31) in test sequences, selection is made between DISABLED and ENABLED. The default setting is DISABLED.

PRINTER MENU

This menu, as shown in Fig. 3-15, allows selections to be made under the following options:-

(a) PRINTER PORT.
(b) PRINT.
(c) TERMINATE.

Pressing RETURN restores the CHANGE FORMAT MENU.

PRINTER PORT selection

This option selects which of the three printer ports, GPIB TALK-ONLY, SERIAL RS-232 or PARALLEL, is to be connected to the printer for producing a printed copy of the results in the GO/NO-GO TEST or the FULL AUTO TEST mode. When a printer is not to be used or is not connected, select UNASSIGNED. Otherwise, a PRINTER TIMEOUT error message may be displayed during the test sequence.

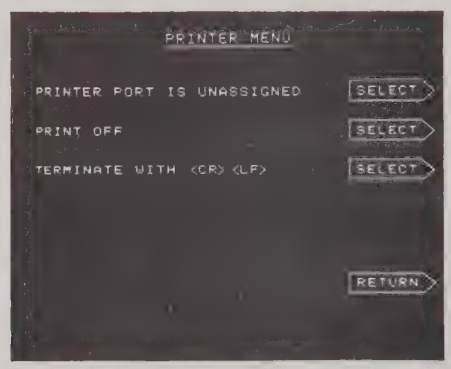


Fig. 3-15 PRINTER MENU

PRINT selection

This option selects the criteria for printing a test routine and its result as ALL, ON FAILURE or ON PASS. When a printout is not required, select OFF.

TERMINATE selection

This option selects the characters which the printer requires to terminate a line. Selections are <CR> and <LF>, <LF> only and <CR> only.

Note...

A printer may be used in 2955 TALK-ONLY mode as follows:-

(1) Connect the printer to the appropriate port and select the parameters from the menus as above.

(2) Switch off both the 2955 and the Adapter.

(3) Set the 2955's GPIB unit to TALK-ONLY (switch 6 to 1) and select the printing mode using switches 1 and 2 as follows:-

Switches 1 and 2	Case	<CR>
00	Upper and lower	Suppressed
01	Upper and Lower	Not suppressed
10	Upper only	Suppressed
11	Upper only	Not suppressed

(4) Switch on both the 2955 and the Adapter then press the HOLD DISPLAY key.

(5) Press PRT to start the printout. Data is now passed from the 2955 through the Adapter to the printer.

(6) When printing is complete, restore the 2955 GPIB unit switch settings to normal.

INTERFACE MENU

This menu, as shown in Fig. 3-16, allows selections to be made under the following options:-

(a) BAUD RATE.
(b) LENGTH/PARITY.
(c) STOP BITS.
(d) GPIB ADDRESS.

Pressing RETURN restores the CHANGE FORMAT MENU.

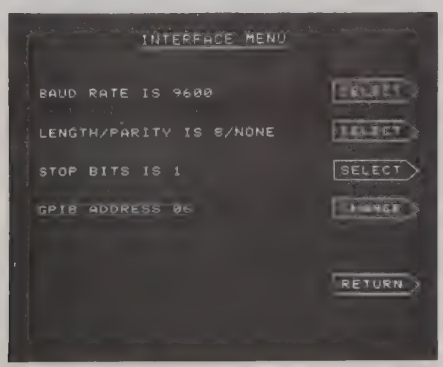


Fig. 3-16 INTERFACE MENU

BAUD RATE **selection**

In order to accommodate different types of printers on the RS-232 port, the serial baud rate is selected from 75, 150, 300, 600, 1200, 2400, 4800 and 9600.

LENGTH/PARITY **selection**

Length and parity for the RS-232 port are selected from 7/EVEN, 7/ODD, 7/NONE, 8/EVEN, 8/ODD and 8/NONE.

STOP BITS **selection**

A stop bit or bits is assigned to the end of every byte which is transmitted to the printer. This is selected from 1 and 2.

GPIB ADDRESS **selection**

Enter the 2-digit GPIB address using the keypad but avoid addresses 0, 1 and 31. Ensure that TALK ONLY is not selected (i.e. that switch 6 is not set to 0) unless the 2957A is only to be used in the 2955 mode (i.e. for use as a printer port converter).

The 2955's GPIB address is shown at the bottom of the display.

MISCELLANEOUS MENU

This menu, as shown in Fig. 3-17, allows selections to be made under the following options:-

(a) DE-MOD SOURCE.
(b) DISC STEP RATE.
(c) PRINTER PORT COMMAND.
(d) SYSTEM CONFIGURATION.

Pressing RETURN restores the **CHANGE FORMAT MENU**.

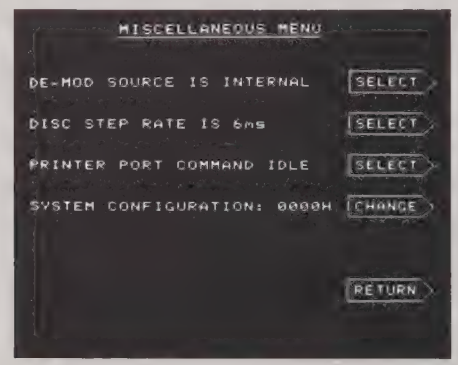


Fig. 3-17 MISCELLANEOUS MENU

DE-MOD SOURCE selection

This selects the method of demodulating the mobile's transmitted signal as INTERNAL (i.e. through 2957A's internal demodulator) or EXTERNAL (i.e. through an external modulation meter). INTERNAL is automatically selected when the 2957A is switched on. The EXTERNAL facility enables the RF section of the mobile to be bypassed so as to test only the modem section.

DISC STEP RATE selection

This selects the disc drive head stepping rate to permit a range of drives to be used. Press SELECT repeatedly until the required value appears for the drive in use. The rates are 6, 12, 20 and 30 ms. The selected rate is saved automatically with any file.

PRINTER PORT COMMAND selection

This is used when the printer is required to print a specified message. Selection is made from the following:-

(a) IDLE. There is no printer output. This is the default selection.

(b) SEND (flashing). This sends a string (which has been entered under the **EDIT COMMAND MENU**) to the printer. Prior to this, appropriate selections have to be made under the **PRINTER MENU** and the printer has to be enabled. After sending, IDLE is restored.

(c) EDIT (flashing). The **EDIT COMMAND MENU** appears. See below.

SYSTEM CONFIGURATION setting

This facility is included so that lesser-used functions and features can be enabled without having full menus. They are enabled by setting bits in two bytes in memory. This is done by entering the equivalent 4-digit hexadecimal number. The bits which are used at present for AMPS are detailed below, the other bits being undefined and reserved for future use. Once an entry has been made for a particular application, it can be saved, along with the other settings, in the non-volatile store.

In internal test sequences, the receiver sensitivity test routine can be replaced by the receiver SINAD test routine. This allows faster operation when only a pass or fail result is required.

In internal test sequences, the data deviation test routine can be included.

The 2957A programming capability has been enhanced over that of the the 2957. In applications where compatibility is required, 2957 emulation can be invoked.

Normally, when a call is received from a mobile, a delay of approximately 2 seconds is applied before a voice channel is assigned. This simulates call validation. This delay can be avoided.

A 4-digit hexadecimal number is shown against SYSTEM CONFIGURATION. Normally, this is 0000H. To invoke any of the above conditions, enter a 4-digit hexadecimal number 00 and two digits which are calculated by adding together the following hexadecimal numbers:-

Setting	Entry
	Hexadecimal (Binary) a + b + c + d where
Receiver sensitivity or SINAD:	
Sensitivity test included	a = 0 (xxxxxxx0)
SINAD test included	or 1 (xxxxxxx1)
Data deviation test:	
Not included	b = 0 (xxxxxx0x)
Included	or 2 (xxxxxx1x)
2957A or 2957 emulation:	
Normal 2957A	c = 0 (xxxxx0xx)
2957 emulation	or 4 (xxxxx1xx)
Voice channel assignment:	
Delay included	d = 0 (xxx0xxxx)
Delay not included	or 10 (xxx1xxxx)

EDIT COMMAND MENU

This menu, as shown in Fig. 3-18, allows entry of a message of up to 30 characters to be sent to the printer whenever this is commanded as above. The default message is a <LF>.

To enter or change the message, press the upper CHANGE key. A table of characters appears at the bottom of the display. Select each character of the message by entering first the line number (1 to 3) followed by the column number (0 to 9). Each selected character appears in the PRINTER PORT COMMAND field. Errors can be rectified by using the DELETE key. The message can be aborted at any time by pressing any other soft key. If the message is not required, it can be removed by deleting characters to leave a blank field.

Fig. 3-18 EDIT COMMAND MENU

Alternatively or subsequently, press the lower CHANGE key. Hexadecimal digits A to F appear at the bottom of the display to show that the 2955's OSCILLOSCOPE keys are used for these. Select each character of the message by entering its 2-digit hexadecimal code for the 2955's character set as given in its Operating Manual. For numbers and upper-case letters, these are the same as ASCII codes. Terminate the message with 0A (i.e. for <LF>). Each selected character appears in the PRINTER PORT COMMAND field. Codes below hexadecimal 20 (decimal 32) or above hexadecimal 7F (decimal 127) can be entered. Each of these is entered directly or subsequently after leaving a space for it and is shown in the PRINTER PORT COMMAND field as a ?.

To move the cursor along (or back the the first position after the last), press ENTER.

Pressing RETURN restores the **MISCELLANEOUS MENU**.

SYSTEM PARAMETER WORD 2 MENU

This is a 'hidden' menu - it is not shown on any of the other menus. To enter, select the **SYSTEM PARAMETERS MENU** and then press the TX TEST key. Then, within 2 seconds, press the 2 key.

This menu allows the user to change certain bits in the overhead message which is sent by the 2957A on a control channel. Each bit which can be changed is shown in the menu as 0 or 1 with a code letter above it as follows:-

Parameter	Code
Serial number	S
Extended address	E
Home registration	H
Roamer registration	R
Discontinuous transmission	D
(Reserved)	R
Read control filler	R
Combined paging and access	C

The default settings are necessary for correct operation of the internal test sequences. However, the user may wish to verify correct operation of a mobile with these bits changed. This would normally be done in a user-defined test sequence or by using the manual test mode.

For a full description of these bits and their significance to the mobile under test, refer to the relevant air-interface specification.

The select the bit, press the SELECT key. The selected bit is shown in reverse video. To change the bit, press the TOGGLE key. To restore all the bits to their default values, press the DEFAULT key. Changes to bits are only retained until the instrument is switched off.

Pressing RETURN restores the **SYSTEM PARAMETERS MENU**.

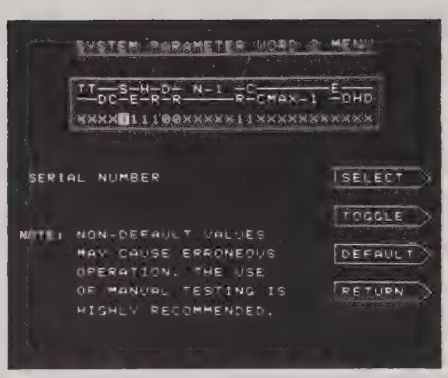


Fig. 3-16 **SYSTEM PARAMETER WORD 2 MENU**

PARAMETER STORAGE

Six full sets of parameters can be stored.

From the main top level menu, select FULL AUTO TEST. The FULL AUTO TEST intermediate display appears as shown in Fig. 3-9.

To store the current settings, press the 2955's STORE key followed by one digit from 1 to 6.

To recall settings, press the 2955's RECALL key followed by the same digit which was used to store the setting. The intermediate display is updated accordingly.

GO/NO-GO TEST MODE

This is designed for rapid operation. It executes the test sequence which has been selected from the **CHANGE FORMAT MENU**. It may be one of the four built-in test sequences or an externally-written test sequence which has been loaded into the 2957A's memory.

The GO/NO-GO TEST mode is accessed from the main top level menu, as shown in Fig. 3-8, by pressing the GO/NO-GO TEST key. The SUMMARY DISPLAY FORMAT display then appears as shown in Fig. 3-19 and the test sequence is immediately started. The DISPLAY FORMAT is automatically set to SUMMARY irrespective of the current setting in the **DISPLAY FORMAT MENU**.

Results of each test routine are shown but the main purpose of using the GO/NO-GO TEST mode is to make a quick appraisal of the mobile so a PASSED, ERROR: or *FAIL* status is displayed for every test routine. This saves the user's time in interpreting data or checking measurements.

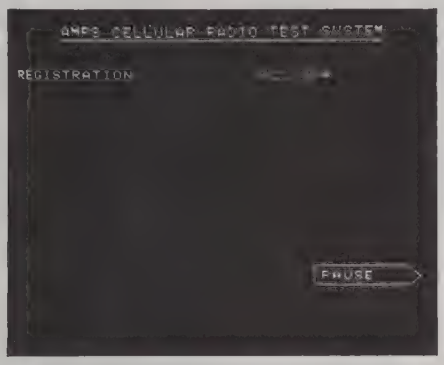


Fig. 3-19 SUMMARY DISPLAY FORMAT display

When printing has been selected from the **PRINTER MENU**, the user can obtain a printout of the test routines and their results using one of the user ports. The format of the printout can be ALL, ON FAILURE or ON PASS depending on the user's selection.

As there may be more than ten test routines in a sequence, scrolling is employed when the screen is full. Failed test routines are collected at the top of the display until the sequence is finished.

In the GO/NO-GO TEST mode, PAUSE is automatically set to MANUAL ONLY irrespective of the current setting in the DISPLAY FORMAT MENU. Pressing the PAUSE key causes the sequence to be stopped at the end of the current test routine and the CONTINUE key appears as shown in Fig. 3-22.

At the end of the test sequence, a summary of the test routines and their results is automatically displayed as shown in Fig. 3-21 so that the user can see if the mobile has failed any of the test routines. For test sequences which contain more than ten test routines, failed ones have priority. Pressing the CONTINUE key causes the mobile's MSN and name of country to appear at the bottom of the screen.

Pressing the RETURN key restores the main top level menu.

FULL AUTO TEST MODE

This executes the test sequence which has been selected from the **CHANGE FORMAT MENU**. It may be one of the four built-in test sequences or an externally-written test sequence which has been loaded into the 2957A's memory. A split screen display is shown so that the service engineer can monitor the RF and AF parameters.

The FULL AUTO TEST mode is accessed from the main top level menu, as shown in Fig. 3-8, by pressing the FULL AUTO TEST key. The FULL AUTO TEST intermediate display then appears as shown in Fig. 3-9. This shows a summary status of the desired test parameters and display formats held in the non-volatile memory since the **CHANGE FORMAT MENU** was last accessed.

To change any of these, press the CHANGE FORMAT key. See page 3-1-18. To save all the format parameters, six non-volatile stores are available. To store the parameters, press the STORE key followed by a number from 1 to 6. To recall these parameters, press the RECALL key followed by the same number. A printed copy of the results can be also be obtained by using the **CHANGE FORMAT MENU**.

To start the test sequence, press the START TEST key.

When FULL DISPLAY FORMAT has been chosen, the display consists of three sections as shown in Fig. 3-20. Most of the top half is the 2955 DUPLEX display. The bottom half displays the limits for the transceiver test routines plus the mobile's MSN and name of country. Separating the two is the current test routine shown being executed, one test routine at a time.

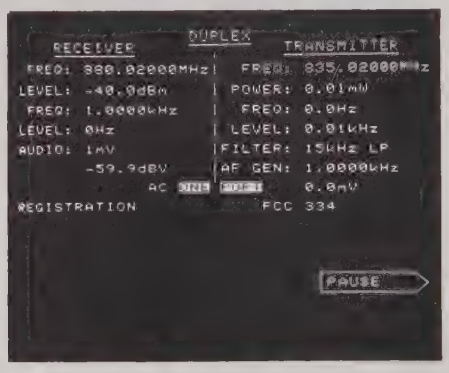


Fig. 3-20 FULL AUTO TEST FULL DISPLAY FORMAT display

When SUMMARY DISPLAY FORMAT has been selected, the display is the same as that for the GO/NO-GO TEST mode as shown in Fig. 3-19. In this case, one line is shown for each test routine so that, as the screen is filled, the lines are scrolled upwards. Failed test routines are collected at the top of the screen.

PAUSE has been previously set to ALWAYS, MANUAL ONLY or ON FAILURE. Pressing the PAUSE key causes the sequence to be interrupted manually at the end of the current test routine. The CONTINUE key appears as shown in Fig. 3-22.

At the end of the test sequence, a summary of the test routines and their results is automatically displayed as shown in Fig. 3-21 so that the user can see which test routines the mobile has failed. For test sequences which contain more than ten test routines, failed ones have priority. Pressing the CONTINUE key causes the mobile's identity to appear at the bottom of the screen.

Pressing the RETURN key restores the FULL AUTO TEST intermediate display.

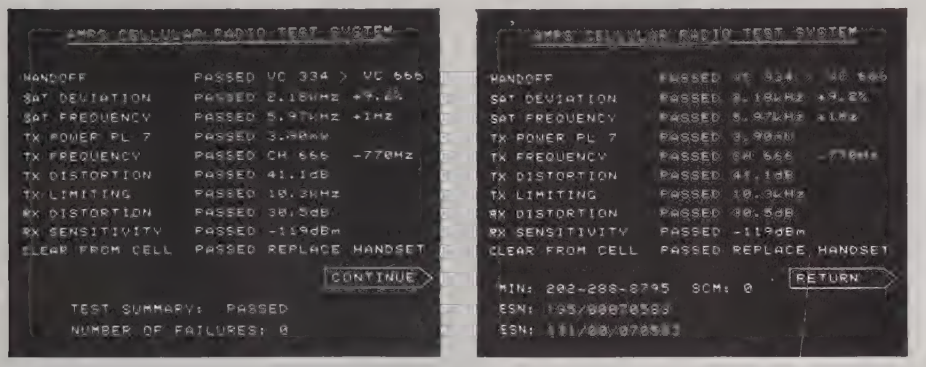

AMPS CELLULAR RADIO TEST SYSTEM
HANDOFF PASSED VC 334 > VC 666
SAT DEVIATION PASSED 2.18kHz +9.2%
SAT FREQUENCY PASSED 5.97kHz +1Hz
TX POWER PL 7 PASSED 3.98mW
TX FREQUENCY PASSED CH 666 -770Hz
TX DISTORTION PASSED 41.1dB
TX LIMITING PASSED 10.3kHz
RX DISTORTION PASSED 30.5dB
RX SENSITIVITY PASSED -119dBm
CLEAR FROM CELL PASSED REPLACE HANDSET
CONTINUE
TEST SUMMARY: PASSED
NUMBER OF FAILURES: 0
RETURN
MIN: 202-288-8795 SCM: 0

Fig. 3-21 Test summary displays

TEST SEQUENCE PAUSE

In the GO/NO-GO TEST mode, the test sequence can be interrupted by pressing the PAUSE key. In the FULL AUTO TEST mode, the PAUSE function can be activated manually, automatically after every test routine or when one has failed. This depends on which was selected from the DISPLAY FORMAT MENU. In all cases, the test sequence is interrupted only at the end of a test routine. When a PAUSE occurs, the CONTINUE key appears as shown in Fig. 3-22. The user can then select one of the following options:-

(a) CONTINUE.
(b) ABORT TESTING.
(c) MANUAL RF TESTING.
(d) DATA.

CONTINUE option

Pressing the CONTINUE key restarts the test sequence from the point at which it was halted.

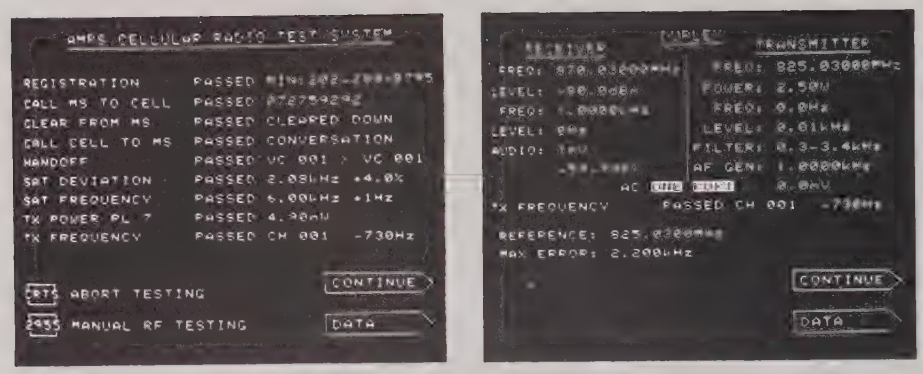


Fig. 3-22 SUMMARY DISPLAY FORMAT and FULL AUTO TEST FULL DISPLAY FORMAT paused displays

ABORT TESTING **option**

To abort the test sequence and access the main top level menu, press the CRTS key. This allows the user to enter the MANUAL TEST facility to carry out specific testing for more detailed fault-finding or to start another test sequence.

MANUAL RF TESTING **option**

When the display shows the 2955 key, the user can press the 2955 key to call up the DUPLEX display which has been automatically set to the parameters of the last test sequence. The user now has manual control of the RF and AF signal generators for alignment and fault finding purposes on the mobile's transceiver circuits. Do not leave DUPLEX operation (i.e. do not press the TX TEST key or the RX TEST key) or the mobile will drop out of service. Press the CRTS key to return to the test sequence.

DATA **option**

The data displays allow the user to view the data messages which are sent by the mobile to the cell and from the cell to the mobile during the call processing test routines and in a MANUAL TEST procedure. These displays allow the user to rapidly identify incorrect bits sent by the mobile which may have caused it to fail. They can also serve as an educational or reference facility for users who are unfamiliar with cellular signalling.

Press the DATA key to access the **REVERSE WIDEBAND DATA** display as shown in Fig. 3-23. In the lower half, this shows the 12 hexadecimal digits of the data frames which have been sent by the mobile on the reverse channels during the last signalling test routine. Each word is normally sent five times so the the 2957A can make a majority decision on the contents. If the repeats match the original word, it is shown together with the number of times that it has been sent.

Press the RETURN key to restore the previous display.

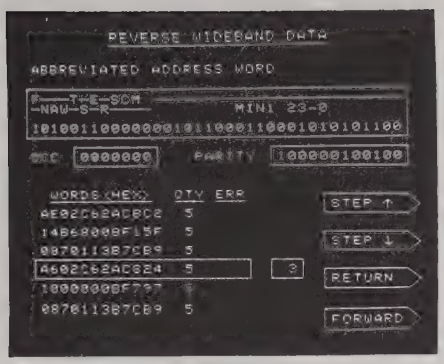


Fig. 3-23 REVERSE WIDEBAND DATA display

Press the FORWARD key to access the **FORWARD WIDEBAND DATA** menu as shown in Fig. 3-24. This calls up part of the forward data stream sent by the 2957A which is the most relevant. Selection is from the following options:-

(a) CONTROL FILLER words. These are null data which are sent when no active information is being transmitted. This enables mobiles to scan continuously for a strong signal onto which they can lock.

(b) OVERHEAD MESSAGE words. These contain certain information which relates to the system parameters of the local network (e.g. SID, available control channels).

(c) MOBILE STATION CONTROL FCC words. These contain commands and messages which are sent to a particular mobile on the forward control channel during registration and call set-up. Each word is repeated a number of times to ensure that the mobile receives the correct data.

(c) MOBILE STATION CONTROL FVC words. These contain commands and messages which are sent to a particular mobile on the forward voice channel during a call (i.e. handoff). Each word is repeated a number of times to ensure that the mobile receives the correct data.

The **FORWARD WIDEBAND DATA** display, as shown in Fig. 3-25. In the lower half, this shows the 10 hexadecimal digits of the data frames which have been sent by the 2957A to the mobile during the last signalling test routine. The frame type is shown together with the number of times that the particular frame has been repeated.

Press the REVERSE key to restore the **REVERSE WIDEBAND DATA** display. Press the RETURN key to restore the previous display.

Fig. 3-24 **FORWARD WIDEBAND DATA** menu

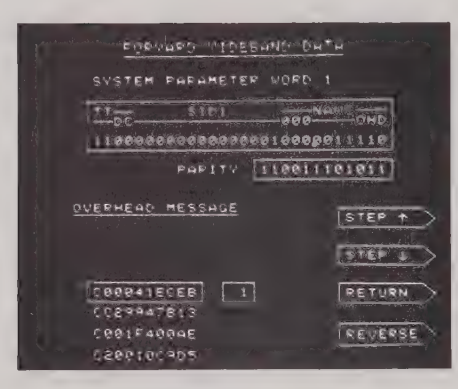


Fig. 3-25 **FORWARD WIDEBAND DATA** display

A frame can be selected for analysis by pressing the STEP ↑ key or the STEP ↓ key until the frame is displayed in the lower box. The frame is then shown as 48 or 40 bits in the box in the upper half together with the frame type in accordance with the AMPS specification.

A frame which contains a single incorrect bit is indicated by a C in the ERR column. If more than one bit is incorrect, the frame is indicated by a flashing E. When the frame is shown in the upper box, the incorrect bit(s) are shown in reverse. This helps the user to determine whether the fault is located on the mobile's logic boards or whether the mobile is having problems with the system in which it is working.

To print the data, enable the printer and then press the RX TEST key. The selected frame is then printed in the form of 48 or 40 bits together with the frame type. Repeated pressing of the TX TEST key prints each successive frame.

MANUAL TEST MODE

This provides the user with manual control of the 2957A. It is intended to be used for troubleshooting and repair rather than for routine testing.

The MANUAL TEST mode is accessed from the main top level menu, as shown in Fig. 3-8, by pressing the MANUAL TEST key. The **MANUAL OPERATION** display then appears as shown in Fig. 3-26. It consists of a generated section shown on the upper half and a measured section with readings shown on the lower half. Besides scanning the keys and checking the data, the system every second searches for SAT and ST. When these are detected, they are shown in reverse on the display. The received DTMF tones, the supply voltage, current and DC power are also shown. If the voltage remains below 1 V for longer than 6 seconds, the supply voltage, current and power readings are disabled. This enables the SAT readings to be updated three times faster than normal thus making adjustment easier.

The user can access the following options:-

(a) CHANNEL.
(b) SAT FREQ and LEVEL and DATA LEVEL.
(c) MODE.
(d) AF PATH.
(e) DATA.

Pressing the CRTS key restores the main top level menu. Pressing the 2955 key calls up the 2955 **DUPLEX** display. If the CRTS key is pressed once again, the user is taken back to the **MANUAL OPERATION** display.

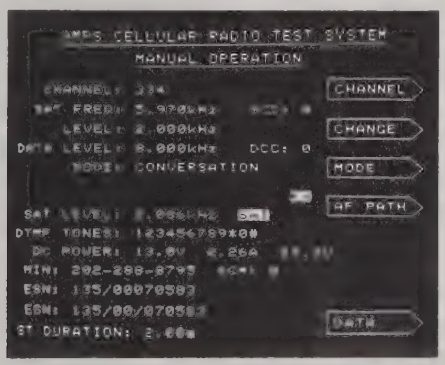


Fig. 3-26 MANUAL OPERATION display

CHANNEL setting

This is selected by pressing the CHANNEL key (which changes to ENTER). The value is then entered on the keypad and terminated with the ENTER key.

This option is normally only used when the user is prompted in the HANDOFF mode. However, it is possible to reverse the 2957A's frequency plans by entering a negative number. This means that the MANUAL TEST procedure could be used for testing certain parameters of a base station such as the SAT filters.

SAT FREQ, SAT LEVEL and DATA LEVEL settings

These are selected by pressing the CHANGE key (which changes to NEXT) and scrolling through to the required setting. Each of the three values is entered on the keypad and terminated with the NEXT key. The default settings of the levels are the AMPS specified nominal levels. The SAT frequency is taken from the setting in the **SYSTEM PARAMETERS MENU**. SCC (SAT colour code) value depends upon the frequency setting of the SAT tone.

MODE selection

This allows the user to select a signalling test mode depending on the state of the mobile under test. Some of the modes are the same as those in the built-in test sequences; others generate a pattern of data which is primarily intended to test a mobile's modem. In the latter case, the user can access the DATA display by pressing the DATA key to check the mobile's responses. When the user selects a mode, screen prompts are given for the user to enter test parameters.

To select the mode, press the MODE key (which changes to SELECT). Scroll through the modes available until the required mode appears. The selected mode is implemented after a 2 second timeout.

These modes operate as follows:-

(a) FCC. This sends continuous forward control channels. If the system ID is different from the current setting, the mobile responds with REGISTRATION.

(b) REGISTRATION. This is similar to the corresponding test routine in the built-in sequences. The mobile's MIN, SCM and ESN are displayed together with, provided the mobile registers successfully, the order qualifier OD HEX. The mode then reverts to FCC.

(c) PAGE MOBILE. This is the built-in CALL CELL TO MOBILE test routine. A flashing prompt, together with the mobile's alert signal, requests the user to ANSWER CALL. Upon the user lifting the handset or pressing the SEND key, the mode changes to conversation and the mobile's SAT deviation is displayed.

(d) PLACE CALL. This is the built-in CALL MOBILE TO CELL test routine. A flashing prompt requests the user to PLACE CALL. On the handset, the user keys in up to 32 digits. When they are received by the 2957A, they are shown at the bottom of the screen, spill-over digits appearing in the line below. The mode changes to conversation and the mobile's SAT deviation is measured and displayed.

(e) DIRECTED RETRY. The prompt CHANPOS: appears so that the user can enter a number between 1 and 127, other numbers being ignored or rejected. A 4-word 'Mobile Station Control Message' is then aimed at the currently registered mobile (FIRSTCHA - CHANPOS + 1 when the serving system status is enabled and FIRSTCHA + CHANPOS - 1 otherwise). There are two 'Directed Retry' words at the end. Only the first CHANPOS field contains a non-zero value, the number which was entered. See EIA IS-3-D 3.7.1.1 and 2.6.3.8.

By using another instrument (2957A, 2955 or RF signal generator), a second control channel can be created. If another 2957A is not being used, the lead from the MOD OUT socket on the Adapter can be split to the EXT MOD IN socket on the 2955 and to the second generator. This can be set to the new channel. The two RF outputs are then fed to a combining network or coupler so that the mobile is able to receive both signals. Care should be taken to ensure that excessive RF power is not applied to the second signal generator.

(f) NEW ACCESS CH. A prompt appears so that the user can enter a new channel number. An overhead message is set up with a 'New Access Channel Global Action Message' appended. The value in NEWACC is the channel number which was entered. See EIA IS-3-D 3.7.1.2.2.

A second instrument can be used as above for DIRECTED RETRY.

(g) DATA OFF. This switches off the 2957A's data generator.

(h) SIGNAL TONE. The 2957A's data generator sends a continuous signal tone of 10 kHz.

(j) DOTTING. The 2957A generates the bit synchronization pattern (a series of alternate 1's and 0's) which normally precedes a data message. This mode is used to 'open' the mobile's modem.

When the CALL MOBILE is answered and when the PLACE CALL is successful, there is another level of modes which operate as follows:-

(a) CONVERSATION. In this mode, the user can test the handset's numerical keys. DTMF tones received by the 2957A are shown on the display. The mobile's transmitted SAT level and the DC power consumption are updated every few seconds.

(b) HANDOFF. When this mode is selected, the user is prompted to select a new channel by the flashing cursor and ENTER sign. The new channel number is entered on the keypad and terminated by pressing the ENTER key. The mobile then changes to the new channel and the mode changes to conversation. The duration of the mobile's signal tone is shown at the bottom of the screen.

(c) POWER LEVEL. When this mode is selected, SELECT changes to ENTER and the level (0 to 7) is entered on the keypad. The mobile changes its transmitter power level accordingly and the mode reverts to conversation.

(d) CLEAR DOWN. This mode is used to terminate the conversation mode and revert to FCC.

AF PATH selection

This is selected by toggling the indicated soft key. It selects which audio signal is routed to the 2955 AF input when 2955 mode is selected and both indicators, CRTS and 2955, are on. The choices are as follows:-

(a) RX. Normal routeing from Adapter AF output to 2955 AF input.

(b) RX X20. Normal routeing from Adapter AF output to 2955 AF input with 26 dB (times 20) amplifier in the path.

(c) TX. The demodulated mobile transmitter signal is fed to the Adapter IF input.

DATA selection

Pressing the DATA key accesses the DATA displays.

BUILT-IN TEST SEQUENCES

A number of test routines are combined into built-in test sequences which can be executed in the GO/NO-GO TEST and the FULL AUTO TEST modes. There are four built-in test sequences to choose from as follows:-

(a) CALL PROCESSING ONLY.
(b) CALL AND RF TESTING.
(c) BRIEF TESTING.
(d) COMPREHENSIVE TESTING.

The required sequence is selected from the **TEST SEQUENCE MENU**. See page 3-1-23.

CALL PROCESSING ONLY sequence

This sequence is the basis of all of the built-in test sequences. It consists of a series of data signalling test routines to check the mobile's ability to initiate and receive calls and to respond to system commands. It is intended for first-line testing of radios which have been reported as faulty to retailers and installers. It can also be used for validation testing to determine whether a unit is suitable for sale or installation. The only connection required is from the mobile's antenna socket to the RF IN/OUT N socket on the 2957A. The sequence of test routines is as follows:-

(a) REGISTRATION OF MOBILE.
(b) CALL MOBILE TO CELL.
(c) DTMF TONES. Optional.
(d) HOOK FLASH. Optional.
(e) CLEAR DOWN FROM MOBILE.
(f) CALL CELL TO MOBILE.
(g) AUTO HANDOFF.
(h) CLEAR DOWN FROM CELL.

CALL AND RF TESTING sequence

As well as performing the CALL PROCESSING ONLY test routines, this also measures the pertinent RF parameters on all of the channels which have been selected in the **SYSTEM PARAMETERS MENU**. It is intended to be used by workshops for first-line testing. This sequence can also be performed using only the RF connection. The sequence of test routines is as follows:-

(a) REGISTRATION OF MOBILE.
(b) CALL MOBILE TO MTX.
(c) DTMF TONES. Optional.
(d) HOOK FLASH. Optional.
(e) CLEAR DOWN FROM MOBILE.
(f) CALL CELL TO MOBILE.
(g) HANDOFF.
(h) TX RF POWER.
(j) TX RF FREQUENCY.
(k) SAT TRANSPONDING.
(m) CLEAR DOWN FROM CELL.

(g) to (m) are repeated for each selected channel.

BRIEF TESTING sequence

This performs some of the standard transceiver test routines in addition to the routines in the CALL AND RF TESTING sequence. It is intended for use by small workshops and regional service centres as their main test facility.

Test routines are performed on three voice channels. The first voice channel is that selected in the **SYSTEM PARAMETERS MENU**; the second and third are determined by the HANDOFF INCREMENT. It is necessary to connect the audio paths between the mobile and the handset to the test system for this sequence as well as from the mobile's antenna to the RF IN/OUT N socket. The sequence of test routines is as follows:-

(a) REGISTRATION OF MOBILE.
(b) CALL MOBILE TO CELL.
(c) DTMF TONES. Optional.
(d) HOOK FLASH. Optional.
(e) CLEAR DOWN FROM MOBILE.
(f) CALL CELL TO MOBILE.
(g) HANDOFF.
(h) SAT TRANSPONDING.
(j) TX RF POWER.
(k) TX RF FREQUENCY.
(m) TX AF DISTORTION (SINAD).
(n) TX MODULATION LIMITING.
(p) RX AF DISTORTION (SINAD).
(q) RX SENSITIVITY.
(r) CLEAR DOWN FROM CELL.

(g) to (r) are repeated for three channels.

COMPREHENSIVE TESTING **sequence**

This is intended for major service centres and manufacturers who wish to test more of the mobile's operational aspects. All of the connections which are shown in Fig. 3-1 are required for this test sequence. The sequence of test routines is as follows:-

(a) REGISTRATION OF MOBILE.
(b) CALL MOBILE TO CELL.
(c) DTMF TONES. Optional.
(d) HOOK FLASH. Optional.
(e) CLEAR DOWN FROM MOBILE.
(f) CALL CELL TO MOBILE.
(g) AUTO HANDOFF.
(h) BIT ERROR RATE.
(j) HANDOFF.
(k) SAT TRANSPONDING.
(m) TX RF POWER.
(n) DC POWER.
(p) TX RF FREQUENCY.
(q) TX AF DISTORTION (SINAD).
(r) TX MODULATION LIMITING.
(s) TX MODULATION COMPRESSION.
(t) RX AF DISTORTION (SINAD).
(u) RX SENSITIVITY.
(v) RX DEMODULATION EXPANSION.
(w) CLEAR DOWN FROM CELL.

(j) to (w) are repeated for each selected channel.

NON-SYSTEM SPECIFIC TEST ROUTINES

The test routines which are not specific to the AMPS system are described below together with any applicable error messages and their meanings. When performing transmitter test routines (no. 1 to no. 5), the 2957A automatically adjusts the audio generator output level in order to excite the mobile at the required nominal deviation. If it cannot get a settled reading of this deviation, the test routine is failed and READING UNSTABLE is reported in the result field. This is normally due to one of the two following causes:-

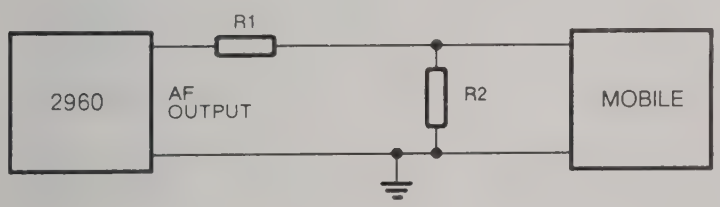
(a) The microphone in the mobile under test is still live and ambient noise is causing the reading to be unstable. This situation should be avoided as it degrades an otherwise good SINAD or distortion measurement.

(b) The corresponding audio generator level is such that the setting resolution is greater than the tolerance of deviation being set (e.g. at 9 mV, with steps of 1mV, gives a setting resolution of 11% which is greater than the acceptance tolerance of ±5%). To rectify this, an attenuator should be inserted to bring the required level above 10 mV.

When performing transmitter limiting test routines, the audio generator output level is adjusted to obtain the nominal deviation. The output level is then increased by an overload factor of 20 dB. If this new level exceeds the maximum output level of the audio generator (2.5 V for a 2955 or 4.0 V for a 2955A or 2955R), then the test routine is failed and the message LOW SENS MIC I/P is displayed. Normally, 250 mV is sufficient to excite a mobile. A low output level could be due to a mismatch, typically a balanced input. In this case, a balun transformer could be used to balance the output of the 2960 and also provide voltage gain.

The effective dynamic range of the audio generator output is 20 log (maximum output level / 10mV) = 48 dB (2955) or 52 dB (2955A or 2955R). As the required dynamic range is 20 dB, the ideal value for the output level is 10 mV + 14 dB = 50 mV (2955) or 10 mV + 16 dB = 63 mV (2955A or 2955R).

Assuming that the mobile has an input impedance of greater than 1 KΩ, see Fig. 3-27 for suitable resistance values to obtain approximate attenuations.



Attenuation	R1	R2
3 dB	33 Ω	68 Ω
6 dB	50 Ω	50 Ω
10 dB	68 Ω	33 Ω
20 dB	91 Ω	10 Ω

Fig. 3-27 AF generator output attenuator

Test routine no. 1 - Transmitter RF power (TX POWER)

Measures the RF power. This is not used in the standard test sequences since the CALL AND RF TESTING, BRIEF TESTING and COMPREHENSIVE TESTING sequences use the system specific power test routine which sets the mobile to the required power levels before measuring. Messages are as follows:-

(a) *FAIL* NO TX POWER. Power <1 mW. Probably there is no carrier so a very low power level is not displayed.
(b) *FAIL* READING UNSTABLE. After 15 attempts, could not obtain two consecutive readings within 20%.

Test routine no. 2 - Transmitter RF frequency (TX FREQUENCY)

First ensures that a carrier is present and then auto-tunes to measure the RF frequency. For cellular radios, then manually retunes to the correct channel. Messages are as follows:-

(a) *FAIL* NO TX POWER. Power <1 mW. Assumes there is no carrier so cannot take meaningful frequency measurement.
(b) *FAIL* READING UNSTABLE. Frequency not within 1% after 15 readings.

Test routine no. 3 - Transmitter AF distortion (TX DISTORTION), transmitter SINAD (TX SINAD), transmitter S/N (TX S/N) and transmitter residual noise (TX NOISE)

Attempts to set the AF level to produce a reference modulation level (but not for the residual noise test routine). Routes the 2957A demodulated signal to the AF INPUT of the 2955 and tests audio as for receiver distortion and SINAD. S/N is measured by reading the demodulated level with and without a modulating signal. Residual noise measurement is deviation of the carrier in the absence of a modulating signal. Messages are as follows:=

(a) *FAIL* LOW DEMOD LEVEL. 2957A internal demodulated level <100 mV either due to 2957A fault or reference modulation level is too low to produce 100 mV demodulated.
(b) *FAIL* READING UNSTABLE. Demodulated level not within 10% after 15 readings.
(c) *FAIL* READING UNSTABLE. Demodulated noise level not within 100% after 15 readings.
(d) *FAIL* READING UNSTABLE. Distortion etc not within 20% after 5 readings.
(e) *FAIL* READING UNSTABLE. Residual noise not within 50% after 10 readings.
(f) AF GEN RESOLUTION ERROR. (Displayed in reverse at the bottom of the screen). Audio generator output level is below 10 mV. This means that, with steps of 1 mV, it may not be possible to set the required deviation to within ±5%.

Test routine no. 4 - Transmitter modulation limiting (TX LIMITING)

Attempts to set an AF level to produce a reference modulation level, then increases the AF level by the overload factor and measures the resulting deviation in a 15 kHz bandwidth (including de-emphasized SAT). Messages are as follows:-

(a) *FAIL* LOW SENS MIC I/P. AF level required to set the transmitter to reference modulation level was too high to overload by the factor given.
(b) *FAIL* NO MODULATION. Deviation <100 Hz/1%/0.1 rad measured.
(c) *FAIL* READING UNSTABLE. Deviation not within 10% after 5 readings.

Test routine no. 5 - Transmitter modulation compression (TX COMPRESSION).

Attempts to set an AF level to produce a reference modulation level, then alters the AF level by +10 dB and -10 dB. Measurement is resulting change in modulation level. Result is (20 dB) / (modulation level change in dB). Messages are as follows:-

(a) *FAIL* LOW DEMOD LEVEL. Demodulated level is below 100 mV. (Demodulated level is reference level + compressed 10 dB change.)
(b) *FAIL* LOW DEMOD LEVEL. Demodulated level is below 10 mV. (Demodulated level is reference level - compressed dB change.)
(c) *FAIL* READING UNSTABLE. Demodulated level not within 10% after 15 readings.
(d) *FAIL* NO MODULATION. ±10 dB change in AF generator output produced <1 dB change in transmitter modulation.
(e) *FAIL* LOW SENS MIC I/P. Cannot modulate to reference level +10 dB (i.e. >2.5 V for a 2955 or >4.0 V for a 2955A or 2955R).
(f) AF GEN RESOLUTION ERROR. (Displayed in reverse at the bottom of the screen). Audio generator output level is below 10 mV. This means that, with steps of 1 mV, it is not possible to set the required deviation to within ±5%.

Note...

When conducting receiver tests, it is necessary to have a recovered audio signal level of >5 mV, corresponding to the required deviation (i.e. 8.0 kHz). Otherwise, the SINAD/distortion measurement may not be accurate. If the recovered level is below 50 mV, then either a fault exists in the interface circuit or there is a gross mismatch. Where there is a balanced output, this may be rectified by using a balun transformer or the Marconi Instruments 600 Ω accessory.

Test routine no. 6 - Receiver distortion (RX DISTORTION), **receiver SINAD** (RX SINAD) and **receiver S/N** (RX S/N)

Sets modulation level directly and measures distortion, SINAD and S/N directly on 2955 through x20 amplifier. 2957A AF IN (mobile's receiver audio) is routed to the 2955 AF IN. Messages are as follows:-

(a) *FAIL* LOW DEMOD LEVEL. Receiver audio level <5 mV (100 mV on display).
(b) *FAIL* READING UNSTABLE. Distortion etc not within 20% after 5 readings.
(c) AF GEN RESOLUTION ERROR. (Displayed in reverse at the bottom of the screen). Audio generator output level is below 10 mV. This means that, with steps of 1 mV, it may not be possible to set the required deviation to within ±5%.

Test routine no. 7 - Receiver sensitivity (RX SENSITIVITY)

Attempts to adjust the receiver level until the mobile's receiver audio produces the reference SINAD reading required. Result is the RF level. Messages are as follows:-

(a) *FAIL* LOW DEMOD LEVEL. Receiver audio level <5 mV (100 mV on display).
(b) *FAIL* NO DEMODULATION. Reached receiver level limit at -95 dBm or -122 dBm without reaching reference SINAD level.
(c) *FAIL* READING UNSTABLE. SINAD not within 20% after 5 readings and 10 iterations of setting level.

Test routine no. 8 - Receiver demodulation expansion (RX EXPANSION)

Sets receiver modulation level directly to reference level -5 dB and +5 dB. Measurement is resulting change in receiver audio level in dB. Result is (audio level change in dB) / (10 dB).

(a) *FAIL* LOW DEMOD LEVEL. Demodulation level <5 mV (reference level -5 dB).
(b) *FAIL* LOW DEMOD LEVEL. Demodulation level <5 mV (reference level +5 dB).
(c) *FAIL* READING INSTABLE. Demodulation not within 10% after 15 readings.
(d) ERROR: MODULATION LIMIT. Cannot modulate to reference level +5 dB.

Test routine no. 9 - DC power consumption (DC POWER).

Routes voltages corresponding to DCV/25 and DCA/10 to 2955; measures DC voltages and calculates power. Messages are as follows:-

(a) *FAIL* NO DC POWER. <250 mV or <100 mA or <100 mW.
(b) *FAIL* READING UNSTABLE. Not within 10% after 15 readings.

Test routines no. 10 to no. 19

Not implemented.

SYSTEM SPECIFIC TEST ROUTINES

The test routines which are specific to the AMPS system are described below together with any applicable error messages and their meanings.

Test routine no. 20 - Registration of mobile on control channel (REGISTRATION)

This test routine checks the mobile's ability to register on the system. Operation is as follows:-

(1) The test routine title is displayed and the 2957A initializes the data generation system as a control channel.

(2) The 2957A generates an FCC for the mobile to lock onto. The FCC number is shown on the display.

(3) If the mobile cannot lock onto the control channel, the 2957A tries again in other systems (independent provider or local company). The message *FAIL* NO RESPONSE means that there is no response or CRTS is aborted.

(4) The mobile locks onto the FCC and sends registration updating messages with the MIN, ESN and SCM.

(5) The 2957A checks the received data and displays the MIN and PASSED for a good test. Failure messages are as follows:-

(a) *FAIL* DATA INCOMPLETE. Not all of the message was received.
(b) *FAIL* DATA CORRUPT. The message was corrupted.
(c) *FAIL* DATA CORRECTED. A bit error has been corrected.
(d) *FAIL* DATA IGNORED. There were insufficient correct repetitions.
(e) *FAIL* TOO MANY WORDS. The message was longer than the format.
(f) *FAIL* WRONG RESPONSE. The response was wrong for the message which was sent.

Test routine no. 21 - Call placement from cell to mobile (CALL CELL TO MS)

This test routine checks the mobile's ability to answer an incoming call. The number called is the currently stored MIN. Operation is as follows:-

(1) The test routine title is displayed.

(2) The 2957A generates an FCC for the mobile to lock onto. PAGING MS is displayed and the mobile is paged every 2 seconds. The message *FAIL* NO RESPONSE means that no response was received within 30 seconds.

(3) The mobile locks onto the FCC and responds with data.

(4) The 2957A checks the received data. Failure messages are as follows:-

(a) *FAIL* DATA INCOMPLETE. Not all of the message was received.
(b) *FAIL* DATA CORRUPT. The message was corrupted.
(c) *FAIL* DATA CORRECTED. A bit error has been corrected.
(d) *FAIL* DATA IGNORED. There were insufficient correct repetitions.
(e) *FAIL* TOO MANY WORDS. The message was longer than the format.
(f) *FAIL* WRONG RESPONSE. The response was wrong for the message which was sent.

(5) The 2957A checks the SCM. The message ERROR: ONLY 666 CHANNELS means that a channel greater than this was attempted.

(6) The 2957A assigns and displays the first voice channel (e.g. VC ASSIGN VC 001).

(7) The mobile tunes to the voice channel.

(8) The 2957A checks for the carrier and displays CARRIER ON or the message *FAIL* NO CARRIER. The failure message means that there was no carrier >100 mW within 5 seconds.

(9) The 2957A sends the alerting order and switches on the SAT.

(10) The mobile responds by switching on the signalling tone.

(11) The 2957A checks for the signalling tone. The message *FAIL* NO SIGNALLING TONE means that no signalling tone was received within 5 seconds.

(12) The mobile rings and ANSWER CALL flashes on the display.

(13) The user either picks up the handset or presses the SEND key, depending upon the audio connections. The signalling tone stops and CONVERSATION appears on the display together with PASSED for a successful test.

Test routine no. 22 - Call placement from mobile to cell (CALL MS to CELL)

This checks the mobile's ability to place a call. Operation is as follows:-

(1) The test routine title is displayed together with WAIT FOR SERVICE.

(2) After 2 seconds, WAIT FOR SERVICE is replaced by PLACE CALL flashing.

(3) The 2957A waits for a response. The message *FAIL* NO RESPONSE means that no response was received within 30 seconds.

(4) The user keys a number (up to 32 digits, only 16 being shown in a summary display) into the handset and presses the SEND key. The mobile sends the MIN, the ESN and the called number.

(5) The 2957A checks the received data. Messages are as follows:-

(a) *FAIL* DATA INCOMPLETE. Not all of the message was received.
(b) *FAIL* DATA CORRUPT. The message was corrupted.
(c) *FAIL* DATA CORRECTED. A bit error has been corrected.
(d) *FAIL* DATA IGNORED. There were insufficient correct repetitions.
(e) *FAIL* TOO MANY WORDS. The message was longer than the format.
(f) *FAIL* WRONG RESPONSE. The response was wrong for the message which was sent.

(6) The 2957A assigns and displays the first voice channel (e.g. VC ASSIGN CH 001).

(7) The mobile tunes to the voice channel.

(8) The 2957A checks for the carrier and displays CARRIER ON or the message *FAIL* NO CARRIER. The failure message means that there was no carrier >100 mW within 5 seconds.

(9) The 2957A switches on the SAT and displays the dialled number with PASSED or the message *FAIL* NO CARRIER. The failure message means that no carrier is present.

Test routine no. 23 - Handoff from current to chosen voice channel (HANDOFF)

This checks the mobile's ability to retune to another voice channel (which has been selected by the user under the **CHANGE FORMAT MENU**) while in conversation mode (e.g. from channel 001 to 666 by an increment of 333). Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A assigns and displays the first voice channel (e.g. VC ASSIGN CH 001).

(3) The 2957A waits for signalling tone confirmation. The message *FAIL* NO SIGNAL TONE means that no ST was received within 3 seconds.

(4) The mobile sends the signalling tone.

(5) The 2957A waits for the mobile's carrier on the new channel. The message *FAIL* NO CARRIER means that a carrier >100 mW was not received within 5 seconds.

(6) The mobile tunes to the new voice channel.

(7) The 2957A confirms successful handoff (e.g. VC 001 >VC334).

(8) The 2957A checks the signalling tone duration and displays PASSED for a good test. The message *FAIL* SIGNAL TONE DURATION means that the duration was not 50 ms ±5 ms or ±10%.

Test routine no. 24 - Automatic handoffs from first to last voice channel (AUTO HANDOFF)

This test routine is based on no. 23. However, the mobile steps from the first channel by the channel increment until the last channel is reached or exceeded (from channel 001 to 600 by increments of 200). Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A assigns and displays the first voice channel (e.g. VC ASSIGN CH 001).

(3) The 2957A waits for signalling tone confirmation. The message *FAIL* NO SIGNAL TONE means that no ST was received within 3 seconds.

(4) The mobile sends the signalling tone.

(5) The 2957A waits for the mobile's carrier on the new channel. The message *FAIL* NO CARRIER means that a carrier >100 mW was not received within 5 seconds.

(6) The mobile tunes to the new voice channel.

(7) The 2957A confirms successful handoff (e.g. CH 001 >CH201).

(8) The handoff is repeated for channels 401 and 600.

(9) The 2957A checks the signalling tone duration and displays PASSED for a good test. The message *FAIL* SIGNAL TONE DURATION means that the duration was not 50 ms ±5 ms or ±10%.

Test routine no. 25 - SAT transponding (SAT TRANSPONDING)

This test routine measures the SAT frequency and deviation. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A tests SAT for transponding and SAT DETECTED is displayed. The message *FAIL* NO SAT DETECTED means that the SAT was not detected.

(3) If required, the SAT deviation is checked. SAT DEVIATION is displayed.

(4) The 2957A takes an average of 8 measurements and PASSED is displayed for a good test. The message *FAIL* READING UNSTABLE means that the measurements are <100 mV or differ by >2%.

(5) If required, the SAT frequency is checked. SAT FREQUENCY is displayed.

(6) The 2957A takes an average of 8 measurements and PASSED is displayed for a good test. The message *FAIL* READING UNSTABLE means that the measurements are <1.000 kHz or differ by >1%.

Test routine no. 26 - Clearing down from cell (CLEAR FROM CELL)

This test routine is the final one in all four built-in test sequences. It is similar to no. 27 except that it checks whether the mobile can acknowledge a call termination by the other party. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) ORDER RELEASE is displayed and the 2957A sends the clearing order and waits for the signalling tone. The message *FAIL* NO SIGNAL TONE means that no ST was received within 30 seconds.

(3) The mobile sends the signalling tone.

(4) When the ST is received, SIGNAL TONE is displayed. When the ST ends, CLEARED DOWN is displayed.

(5) The 2957A checks the signalling tone duration and PASSED is displayed for a good test. The message *FAIL* SIGNAL TONE DURATION means that the ST duration was not 1.8 s ±50 ms or ±10%.

Test routine no. 27 - Clearing down from mobile (CLEAR FROM MS)

This test routine checks the mobile's ability to terminate the call which it has made in the previous test. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) END CALL flashes and the 2957A waits for the signalling tone. The message *FAIL* NO SIGNAL TONE means that no ST was receieved within 20 seconds.

(3) The user replaces the handset or presses the END key.

(4) The mobile sends the signalling tone.

(5) When the ST is received, SIGNAL TONE is displayed. When the ST ends, CLEARED DOWN is displayed.

(6) The 2957A checks the signalling tone duration and PASSED is displayed for a good test. The message *FAIL* SIGNAL TONE DURATION means that the ST duration was not 1.8 s ±50 ms or ±10%.

Test routine no. 28 - Mobile transmitter RF power (TX POWER PL x)

This test routine checks up to all eight of the mobile's RF power levels. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR:NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A instructs the mobile to set a power level and then waits for a response. The power level number appears on the display. The message *FAIL* NO RESPONSE means that no response was received within 700 ms.

(3) The mobile acknowledges and then sets the power level.

(4) The 2957A decodes the response. Messages are as follows:-

(a) *FAIL* DATA INCOMPLETE. Not all of the message was received.
(b) *FAIL* DATA CORRUPT. The message was corrupted.
(c) *FAIL* DATA CORRECTED. A bit error has been corrected.
(d) *FAIL* DATA IGNORED. There were insufficient correct repetitions.
(e) *FAIL* TOO MANY WORDS. The message was longer than the format.
(f) *FAIL* WRONG RESPONSE. The response was wrong for the message which was sent.

(5) The 2957A takes an average of 4 measurements of the mobile's power level with reference to its SCM. The message *FAIL* READING UNSTABLE means that the measurements are <1 mW or differ by >2%.

(6) If required, the 2957A instructs the mobile to reset the power level and then takes another measurement.

(7) PASSED is displayed for a good test. The message *FAIL* x.xxW means that the power level is outside limits.

Test routine no. 29 - Bit error rate (BIT ERROR RATE)

This test routine checks the accuracy of the mobile's data reception under low level conditions. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A checks the RF generator level parameter. Messages are as follows:-

(a) ERROR: PARAMETER RANGE. The level was outside the parameter range.
(b) ERROR: PARAMETER UNITS. The level was not in dBm.

(3) The 2957A sets the RF generator level and then checks the bit error rate lower limit parameter. Messages are as follows:-

(a) ERROR: PARAMETER RANGE. The level was outside the parameter range.
(b) ERROR: PARAMETER UNITS. The level was not in % units.

(4) The 2957A sends an audit order to the mobile and waits for a confirmation message.

(5) The 2957A waits for the SAT to be transponded. The message *FAIL* SAT DROPOUT means that no SAT was detected within 3 seconds.

(6) The 2957A checks for response and logs success.

(7) The 2957A checks 10 times for any response. If no response is received, the test is aborted. Otherwise, the test repeats from (4) another 99 times. The message *FAIL* NO RESPONSE means that there was no response after 10 tests.

(8) After 100 successful tests, PASSED is displayed together with the % bit error rate. The message *FAIL* xxx% means that the percentage pass was outside the limit.

Test routine no. 30 - DTMF tones (DTMF TONES)

This test routine checks the mobile's ability to generate DTMF tones at the correct frequency. This is optional and has to be enabled or disabled under the **TEST SEQUENCE MENU**. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A checks that this test routine is enabled. The message ERROR: NOT ENABLED means that it is not.

(3) WAITING FOR TONES is displayed and the 2957A waits for the tones. The message *FAIL* NO RESPONSE means that no tones were received within the time limit.

(4) On the handset, the user presses the number, * and # keys. This transmits tone pairs with each key press. These can be heard when the volume is turned up.

(5) The data symbols are displayed (i.e. 1 2 3 4 5 6 7 8 9 0 * #) for confirmation sequentially as they are received.

(6) The user checks the symbols for accuracy and then presses CONTINUE. This causes PASSED to appear on the display.

Test routine no. 31 - Hook flash (HOOK FLASH)

This test routine checks the mobile's ability to send a hook flash signalling tone of the correct duration and interrogates the mobile for the hook flash data. This is optional and has to be enabled or disabled under the **TEST SEQUENCE MENU**. Operation is as follows:-

(1) The test routine title is displayed and the 2957A tests for conversation mode. The message ERROR: NO VOICE CHANNEL means that the previous call placement has failed.

(2) The 2957A checks that this test routine is enabled. The message ERROR: NOT ENABLED means that it is not.

(3) The 2957A requests the user to send flash and waits for the signalling tone. The message *FAIL* NO RESPONSE means that there was no ST within 20 seconds.

(4) On the handset, the user enters numerical data and then presses the SEND key. A signalling tone is transmitted. This can be heard when the volume is turned up.

(5) The 2957A receives the tone and instructs the mobile to send the called address.

(6) The called address is displayed for confirmation. Messages are as follows:-

(a) *FAIL* DATA INCOMPLETE. Not all of the message was received.
(b) *FAIL* DATA CORRUPT. The message was corrupted.
(c) *FAIL* DATA CORRECTED. A bit error has been corrected.
(d) *FAIL* DATA IGNORED. There were insufficient correct repetitions.
(e) *FAIL* TOO MANY WORDS. The message was longer than the format.
(f) *FAIL* WRONG RESPONSE. The response was wrong for the message which was sent.

(7) The 2957A checks the signalling tone duration and PASSED is displayed for a good test. The message *FAIL* SIGNAL TONE DURATION means that the ST duration was not 400 ms ±50 ms or ±10%.

Test routine no. 32 - Data deviation (DATA DEVIATION)

This test routine is used to measure the mobile's data deviation while in conversation. A reference level of 8 kHz is used with a maximum error which has a default value of 10%. The maximum error parameter can be specified in % or Hz. This is checked for valid units and range. Operation is as follows:-

(1) Upon initialization, the test routine title is displayed and a check is made to ensure that the mobile is in conversation. If not, the message NO VOICE CHANNEL is displayed and the test routine is terminated.

(2) The maximum error parameter is checked to see that it has the correct units and is within the correct range (0 to 100% or 0 to 8 kHz). If not, the message PARAMETER UNITS or PARAMETER RANGE is displayed and the test routine is terminated.

(3) The 2957A sends an audit order to the mobile. The deviation of the mobile's response is then measured. If there is no response from the mobile, the message NO RESPONSE is displayed and the test routine is terminated.

(4) Provided the measurement was successful, the result is displayed and the test routine is passed if it is within the specified limits. If the measurement was not successful, the message BELOW THRESHOLD or READING UNSTABLE is displayed. Possible messages are as follows:-

(a) PASSED x.xxkHz ±xxxHz.
(b) PASSED x.xxkHz ±xx%.
(c) ERROR: PARAMETER UNITS.
(d) ERROR: PARAMETER RANGE.
(e) *FAIL* NO RESPONSE.
(f) *FAIL* BELOW THRESHOLD.
(g) *FAIL* READING UNSTABLE.
(h) *FAIL* x.xxkHz ±xxxHz.
(j) *FAIL* x.xxkHz ±xx%.

Test routine no. 33 - Signalling tone deviation (ST DEVIATION)

This test routine is used to measure the mobile's signalling deviation. To obtain a valid result, it has to follow a test routine no. 21 because the deviation is measured and stored while the mobile is ringing in the test routine no. 21. A reference level of 8 kHz is used with a maximum error which has a default value of 10%. The maximum error parameter can be specified in % or Hz. This is checked for valid units and range. Operation is as follows:-

(1) Upon initialization, the test routine title is displayed.

(2) The maximum error parameter is checked to see that it has the correct units and is within the correct range (0 to 100% or 0 to 8 kHz). If not, the message PARAMETER UNITS or PARAMETER RANGE is displayed and the test routine is terminated.

(3) A check is made to see that a valid ST deviation reading has been taken. If not, the message NO READING is displayed and the test routine is terminated.

(4) Provided the measurement was successful, the result is displayed and the test routine is passed if it is within the specified limits. Possible messages are as follows:-

(a) PASSED x.xxkHz ±xxxHz.
(b) PASSED x.xxkHz ±xx%.
(c) ERROR: PARAMETER UNITS.
(d) ERROR: PARAMETER RANGE.
(e) *FAIL* NO READING.
(f) *FAIL* x.xxkHz ±xxxHz.
(g) *FAIL* x.xxkHz ±xx%.

Test routine no. 34 - Signalling tone duration (ST DURATION)

This test routine is used to measure the duration of the mobile's signalling tone. To obtain a valid result, it has to follow a test routine no. 23, 24, 26, 27 or 31 because the ST duration is measured and stored during these test routines. The reference duration is dependent on the test routine as follows:-

Test routine no.	Test type	Reference duration
23	Handoff	50 ms
24	Automatic handoff	50 ms
26	Clear from cell	1.8 s
27	Clear from mobile	1.8 s
31	Hook flash	400 ms

A maximum error is used. In all cases, it has a default value of 10%. The maximum error parameter can be specified in % or Hz. This is checked for valid units and range. Operation is as follows:-

(1) Upon initialization. the test routine title is displayed.

(2) The maximum error parameter is checked to see that it has the correct units and is within the correct range (0 to 100% or 0 to 10 s. If not, the message PARAMETER UNITS or PARAMETER RANGE is displayed and the test routine is terminated.

(3) A check is made to ensure that a valid ST duration reading has been taken. If not, the message NO READING is displayed and the test routine is terminated.

(4) Provided the measurement was successful, the result is displayed and the test routine is passed if it is within the specified limits. Possible messages are as follows:-

(a) PASSED xx.xs ±x.xs.
(b) PASSED xx.xs ±xx%.
(c) ERROR: PARAMETER UNITS.
(d) ERROR: PARAMETER RANGE.
(e) *FAIL* NO READING.
(f) *FAIL* xx.xs ±x.xs.
(g) *FAIL* xx.xs ±xx%.

Test routines nos. 35 to no. 39

Not implemented.

Chapter 3-2

REMOTE OPERATION

REMOTE CONTROL

The 2957A can be controlled remotely either from a GPIB controller or through the RS-232 serial interface.

The serial interface gives control from a dumb ASCII terminal, from a computer with a serial port or through a modem. In RS-232 operation, the commands are the same as for GPIB operation with the addition of commands which are specific to RS-232. For ease of use with a modem, the ECHO command can be used to cause any character which is sent to the 2957A to be echoed back to the terminal.

There are three remote control modes as follows:-

(a) Remote pass-through. To control the 2955.
(b) Remote CRTS immediate. To control the 2957A.
(c) Remote CRTS learn. To enter a program.

The descriptions below assume that the controller is correctly connected and that the appropriate programming procedure is used. Refer to the manufacturer's literature.

Note...

Remote operation may be slowed down when data is being generated.

REMOTE PASS-THROUGH MODE

This mode can be entered by one of the following methods:-

(a) From 2955 local mode (i.e. the mode which is entered at switch-on), by the 2957A receiving either REMOTE from the GPIB or by any character appearing at the RS-232 input.

(b) From remote CRTS immediate mode, by receiving the program code NOrmal from the controller.

In this mode, the incoming data is routed straight to the 2955. The only data check is to see whether the input string contains the program code CRTS. When CRTS is received, the system enters the remote CRTS immediate mode.

When the 2957A is addressed to talk in GPIB operation, it similarly addresses the 2955 to talk and holds off the external bus until it has received the data from the 2955 and placed it in its output buffer. Holdoff is then released and the data is sent out.

In RS-232 control, the SRQ function on the 2955 has to be enabled so that the program knows when there is data ready to be sent out.

This mode can be exited by one of the following methods:-

(a) To 2955 local mode, by GTL from the GPIB or by the program code LOCal through the RS-232 input.

(b) To 2955 local mode, by pressing the LOCAL key on the Adapter's front panel.

(c) To remote CRTS immediate mode, by the program code CRTS from the controller.

For a summary of entering and exiting modes, see Fig. 3-28.

REMOTE CRTS MODES

These modes can be entered by one of the following methods:-

(a) From local CRTS mode, by the 2957A receiving REMOTE from the GPIB or by any character appearing at the RS-232 input.

(b) From remote pass-through mode, by the program code CRTS from the controller.

The 2957A goes into the remote CRTS immediate mode which is indicated by WAITING FOR RUN being shown on the display. At this point, changes can be entered as immediate mode commands which change the test sequence, format, etc. When run is initiated by <RETURN> (which is equivalent to pressing START TEST in local mode), this causes the test sequence which is displayed on the screen to be executed. The test sequence is that previously selected either from the **CHANGE FORMAT MENU** or by using the change procedure below.

When the program code LEarn is sent, followed by <RETURN>, the 2957A goes into the remote CRTS learn mode which is indicated by IN LEARN MODE being shown on the display. A program can then be entered, terminated with the program code END. Pressing <RETURN> redisplays the message WAITING FOR RUN. When required, the program can be saved on disc using the program code SAve.

The remote CRTS immediate mode can be exited by one of the following methods:-

(a) To local CRTS mode, by GTL from the GPIB or by the program code LOCal through the RS-232 input.

(b) To local CRTS mode, by pressing the LOCAL key on the Adapter's front panel.

(c) To remote pass-through mode, by the program code NORmal from the controller.

For a summary of entering and exiting modes, see Fig. 3-5.

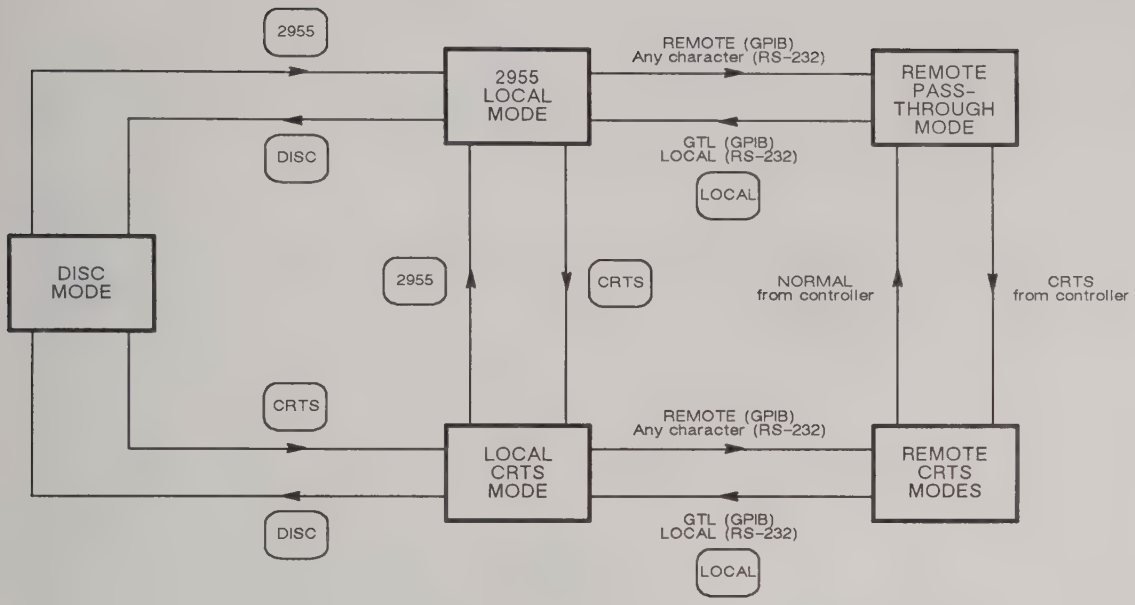


Fig. 3-28 Entering and exiting modes

PROGRAMMING

See the Programming Manual.

Chapter 4-1

BRIEF TECHNICAL DESCRIPTION

INTRODUCTION

The Radio Test System 2957A consists of a Radio Communications Test Set 2955 series with a Cellular Adapter. See Fig. 4-1. For the brief technical description of the 2955, see Chap. 4-1 of the Operating Manual for the 2955.

Between the 2955 and the Adapter, there are three signal paths as follows:-

(a) The 2955's IF output signal is passed to the Adapter to be demodulated.

(b) The modulation signal which is generated by the Adapter is passed to the 2955 to modulate its RF output.

(c) The audio signal which is processed by the Adapter is passed to the 2955 to measure the level and/or the frequency.

ADAPTER BOARDS

The Adapter contains the following boards:-

(a) Motherboard A1.
(b) Keyboard A2.
(c) Keyboard interface board A3.
(d) Personality board B4.
(e) DC power supply board A4 or AC/DC power supply board A7.

MOTHERBOARD A1

The majority of the Adapter's functions are performed by the motherboard A1. The following circuits are included:-

(a) Microprocessor with system memories.
(b) System timer.
(c) GPIB interfaces (internal to 2955 and external).
(d) Disc control interface.
(e) Interfaces for the serial and parallel control ports.
(f) Demodulator.
(g) SAT generator.

KEYBOARD A2 AND KEYBOARD INTERFACE BOARD A2

The interface board A3 buffers the data from the keyboard A2 and transfers data in the other direction to illuminate the indicating LEDs above the four front-panel push-button switches.

PERSONALITY BOARD B4

The personality board B4 has its own memory which enables the Adapter to perform the functions which are specific to AMPS.

The following circuits are included on this board:-

(a) FSK modem.
(b) DTMF receiver and two generators.
(c) SAT filters and detector.
(d) Signalling tone filter and detector.
(e) De-emphasis filter.
(f) Psophometric filter.

For demodulation and for modulation, the modem converts between FSK data and serial data. A USART converts between this serial data and the parallel data of the microprocessor.

For demodulation, the DTMF receiver converts tones into data for the microprocessor. For modulation, the DTMF generators convert data into tones.

Each SAT and signalling tone filter passes its appropriate frequency which, when it is present, activates the relevant detector.

The de-emphasis and psophometric filters are used when noise measurements are to be made on an audio signal.

The appropriate circuits are connected to the motherboard A1 for the following signals:-

(a) Demodulated input signal from the motherboard A1.
(b) Modulation output signal to the motherboard A1.
(c) AF output signal to the motherboard A1, for measurement of level and/or frequency by the 2955.

DC POWER SUPPLY BOARD A4

The AC supply is fed from the AC SUPPLY IN connector to the AC SUPPLY OUT connector and then through fuses, the SUPPLY ON switch and the voltage selector to a mains transformer. The two halves of the primary of the transformer are connected in series for 230 V and in parallel for 115 V.

There are two secondary windings which are connected to full-wave rectifiers on the power supply board A4. A switched-mode regulator supplies the +5 V DC and two linear regulators provide the +12 V and -12 V DC supplies.

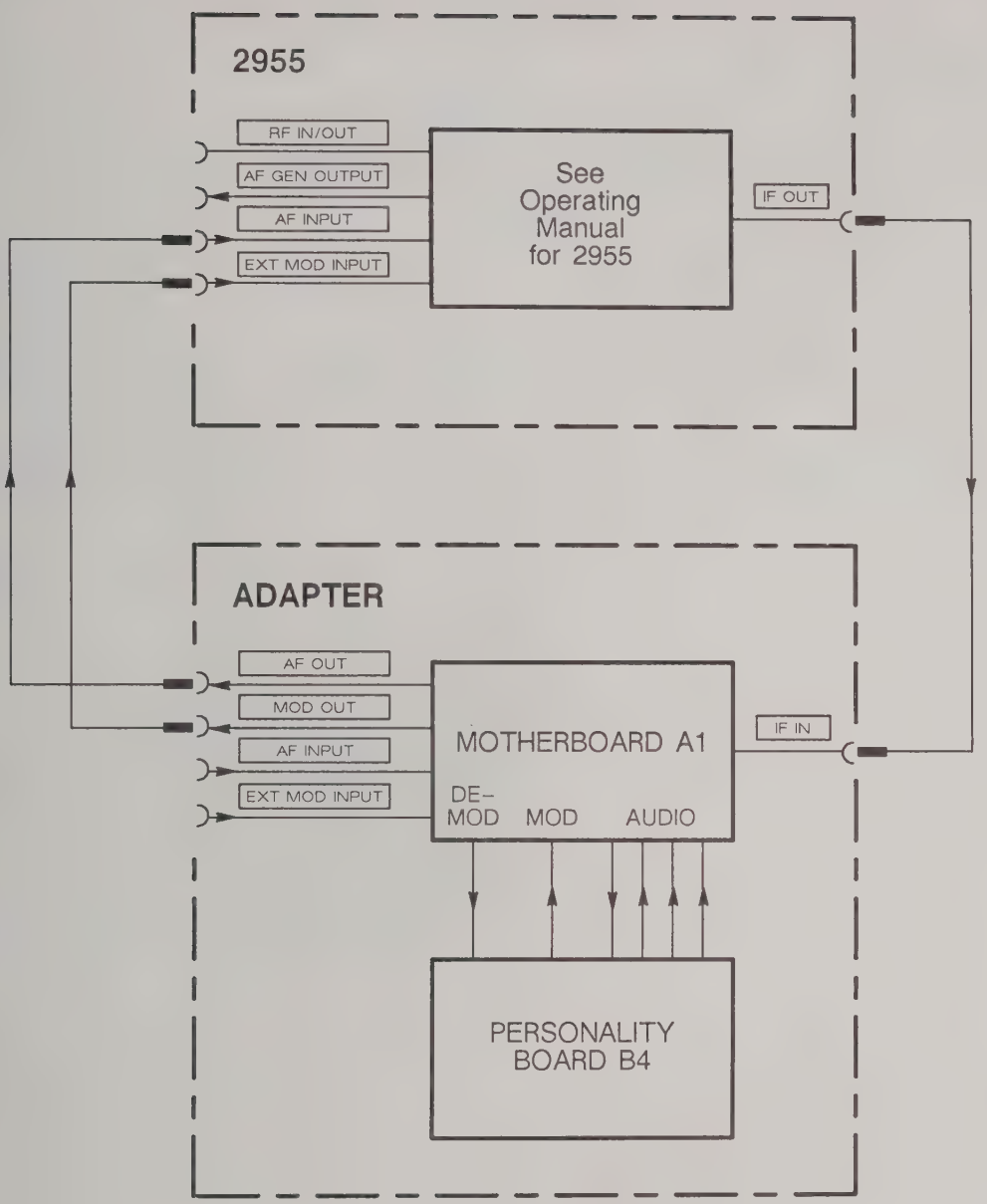


Fig. 4-1 Signal paths

AC/DC POWER SUPPLY BOARD A7

The AC supply is fed from the AC SUPPLY IN connector to the AC SUPPLY OUT connector and then through fuses, the SUPPLY ON switch and the voltage selector to a mains transformer. The two halves of the primary of the transformer are connected in series for 230 V and in parallel for 115 V.

One of the two secondary windings is connected to a full-wave rectifier on the power supply board A7.

The DC supply from the DC connectors and the output from the rectifier are fed to the contacts of a relay. When AC is present, the rectifier output is fed to another full-wave rectifier. When AC is not present, DC is fed to this rectifier.

A switching regulator supplies +5 V DC, +12 V DC and -12 V DC through an isolating transformer. Feedback is taken through an optical coupler.

Chapter 5

ACCEPTANCE TESTING

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SAT GENERATOR

Distortion

Specification:

SAT generator distortion	Less than 2% at 4 kHz ±45 Hz, less than 2% at 6 kHz ±30 Hz.

Test equipment:

Reference	Description	Minimum specification	Example
a	Distortion meter	3 to 8 kHz, measuring capability <0.2%	Marconi TF 2331A or HP 8903

Procedure:

(1) Switch on the instrument and press the CRTS key.

(2) When the equipment has completed its self-test, select MANUAL TEST.

(3) Select MANUAL TEST and, under MODE, select DATA OFF.

(4) Using the CHANGE key and the data keypad, set the SAT frequency to 5970 Hz.

(5) Set the SAT level to 2.5 kHz and the data level to 0 kHz.

(6) Connect a 50 Ω termination to the Adapter's EXT MOD I/P socket (to cut out any pick-up). Connect the Adapter's MOD O/P socket to the distortion meter input.

(7) Measure the distortion, checking that it is within 2%. (If the 2331A distortion meter is used, the reference should be set on the 10% range due to the low level of output from the Adapter's MOD O/P socket.)

(8) Repeat for the other SAT frequencies 6000 and 6030 Hz .

Frequency and deviation accuracy

Specification:

Frequency range	3 to 8 kHz.
Frequency accuracy	±1 Hz.
Deviation accuracy	±10% for deviations of 300 Hz to 2.5 kHz at system frequencies (3.955 kHz to 4.045 kHz and 5.970 kHz to 6.030 kHz).

Test equipment:

Reference	Description	Minimum specification	Example
b	Counter/timer	Period measurement accuracy <5 parts/10^6	Marconi 2437
c	Modulation meter	RF in up to 1000 MHz FM, noise averaging, 50 Hz to 15 kHz filter, LF output	Marconi 2305

Procedure:

(1) Connect the 2955 RF IN/OUT N socket to the modulation meter RF input socket and connect the counter/timer to the modulation meter LF output socket as shown in Fig. 5-1.

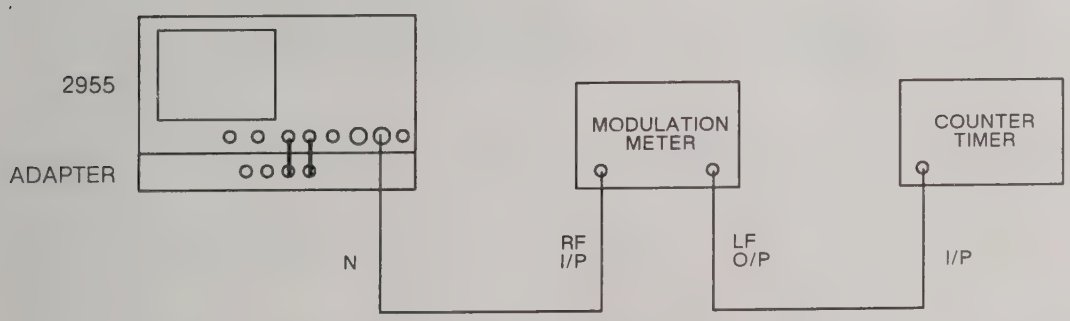

Fig. 5-1 Test equipment for SAT frequency and deviation tests

(2) Switch on the instrument and press the CRTS key.

(3) When the equipment has completed its self-test, select MANUAL TEST.

(4) Select MANUAL TEST and, under MODE, select DATA OFF.

(5) Using the CHANGE key and the data keypad, set the SAT generator to the first row of settings shown in Table 5-1 or Table 5-2.

TABLE 5-2 SAT GENERATOR SETTINGS

SAT frequency	SAT level	Data level	Counter/timer limits
5970 Hz	2 kHz	0 kHz	67476.2 to 167532.3
6000 Hz	2 kHz	0 kHz	166638.9 to 166694.5
6030 Hz	2 kHz	0 kHz	165809.9 to 165864.9

(6) The SAT modulated carrier level has to be increased for it to trigger the modulation meter. To achieve this, press 2955 and then RX. If the 2955 key is inadvertently pressed twice (indicated by the 2955 LED on and the CRTS led OFF), the SAT is switched off. (To recover, press CRTS, 2955 and RX).

(7) Set the modulation meter to monitor FM noise average in a 50 Hz to 15 kHz bandwidth. Set the LF level potentiometer to the brown marker (2305).

(8) Set the counter/timer to measure period on the ns range. (This is required to achieve the correct accuracy and resolution.)

(9) Check on the modulation meter that the deviation displayed is within ±10% of the set SAT deviation level.

(10) Check on the counter/timer that the period indicated is within ±1 Hz, (i.e. within the limits shown in the right hand column of the above tables).

Note... If problems are encountered triggering the counter/timer, return to manual operation and increase the SAT level to 2 kHz deviation to carry out the counter measurements. (To return to MANUAL mode, press the CRTS key.)

(11) Repeat the check for the other SAT frequencies.

SAT MEASUREMENT

Specification:

Accuracy	±10% at nominal system SAT frequencies and level.

Test equipment:

Reference	Description	Minimum specification	Example
c	Modulation meter	400 to 1000 MHz FM, noise averaging, 50 Hz to 15 kHz filter, measurement accuracy <2%	Marconi 2305
d	Signal generator	450 to 1000 MHz, 13 dBm, external FM capability	Marconi 2019A
e	Synthesized LF generator	0 to 7 kHz, 1 V RMS	R & S SPN or HP 3325

Procedure:

Note... The Adapter measures SAT deviation in a very narrow bandwidth centred on the SAT frequency. Independent filters of this characteristic are not generally available. Therefore, the test method is written around a good quality modulation meter with an internationally recognized filter bandwidth and noise averaging selected.

(1) Connect the LF generator output socket to the signal generator external modulation input socket and connect the signal generator output socket to the modulation meter input socket as shown in Fig. 5-3.

(2) Set the LF generator to give an output of 6 kHz at a level suitable for the signal generator being used.

(3) Set the signal generator to a frequency of 835.020 MHz, 2 kHz external deviation, RF level 13 dBm.

(4) Set the modulation meter to monitor FM in a 50 Hz to 15 kHz bandwidth with noise average selected.

(5) Note the deviation displayed on the modulation meter.

(6) Switch on the Adapter and press the CRTS key.

(7) Select MANUAL TEST.

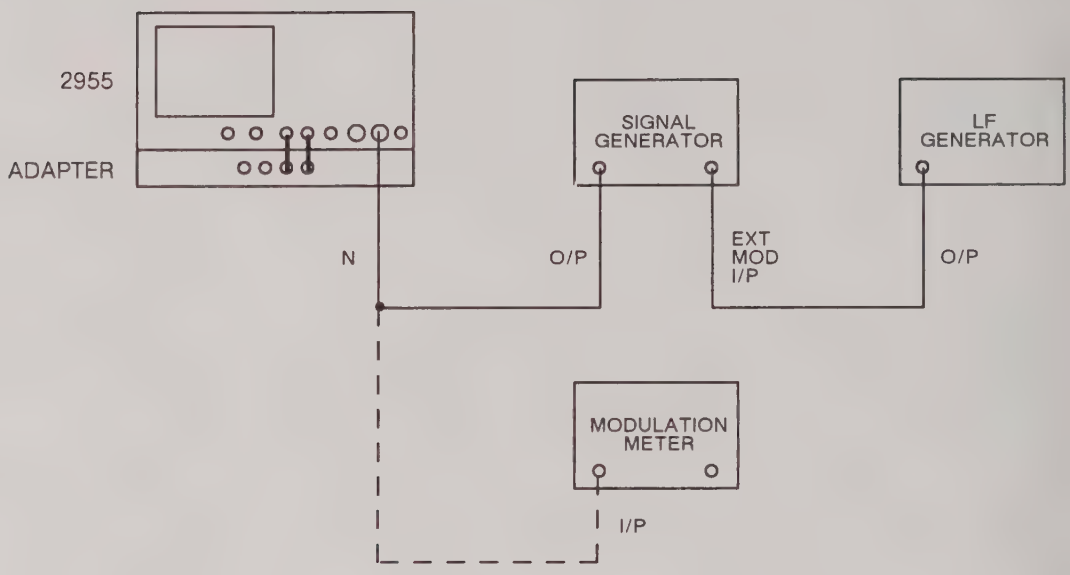

Fig. 5-3 Test equipment connections for SAT measurement test

(8) Set the channel to 323 and the mode to FCC.

(9) Using the CHANGE key and the data keypad, set the SAT generator frequency to the same frequency as that set on the LF generator. The CHANGE key should now have changed to NEXT and the flashing cursor should be under the SAT level.

(10) Press the NEXT key twice. The flashing cursor should disappear. (Although the SAT generator output is not actually used during this check, the SAT generator frequency has to be set always to the same frequency as that set on the LF generator in order to ensure that the correct internal calibration table is used.)

(11) Connect the signal generator output to the 2955 RF IN/OUT N socket.

(12) Check that SAT appears in reverse on the screen and that the SAT level displayed is within ±10% of the deviation noted on the modulation meter.

(13) Repeat for LF generator frequencies of 5.970 and 6.030 kHz.

PSOPHOMETRIC FILTER - C-MESSAGE

Specification:

C-message response	60 Hz	55.7 ±2 dB.
	100 Hz	42.5 ±2 dB.
	200 Hz	25.0 ±2 dB.
	300 Hz	16.5 ±1 dB.
	400 Hz	11.4 ±1 dB.
	500 Hz	7.5 ±1 dB.
	600 Hz	4.7 ±1 dB.
	700 Hz	2.7 ±1 dB.
	800 Hz	1.5 ±1 dB.
	900 Hz	0.6 ±1 dB.
	1 kHz	0 reference.
	1.2 kHz	0.2 ±1 dB.
	1.3 kHz	0.5 ±1 dB.
	1.5 kHz	1.0 ±1 dB.
	1.8 kHz	1.3 ±1 dB.
	2.0 kHz	1.3 ±1 dB.
	2.5 kHz	1.4 ±1 dB.
	2.8 kHz	1.9 ±1 dB.
	3.0 kHz	2.5 ±1 dB.
	3.3 kHz	5.2 ±2 dB.
	3.5 kHz	7.6 ±2 dB.
	4.0 kHz	14.5 ±3 dB.
	4.5 kHz	21.5 ±3 dB.
	5.0 kHz	28.5 ±3 dB.
	Attenuation to increase thereafter at 12 dB/octave up to 60 dB.	

Test equipment:

Reference	Description	Minimum specification	Example
e	Synthesized LF generator	50 Hz to 5 kHz, 2 V RMS	R & S SPN or HP 3325
f	DVM	AC: RMS accuracy <0.5%, DC volts: 1 MΩ, accuracy <0.5%	Solatron 7150+ or Datron 1065A

Procedure:

(1) Connect the LF synthesizer output socket to the Adapter's AF INPUT socket and connect the Adapter's AF OUT socket to the DVM input socket as shown in Fig. 5-5.

Note... As short a lead as possible should be used from the Adapter AF OUTPUT to the DVM as a long lead can cause the output to oscillate. If this problem still occurs during the test, connect a 470 Ω resistor in series with the AF OUTPUT. This does not affect the results of the test.

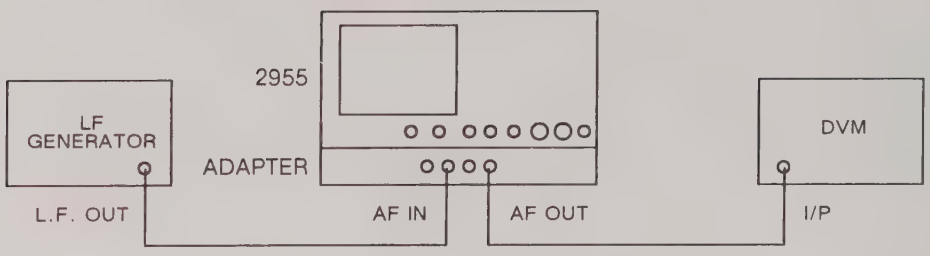

Fig. 5-5 Test equipment connections for psophometric filter test

(2) Switch on the equipment and check that the LED lights above the Adapter's 2955 key.

(3) Set the LF synthesizer to give a 1 kHz sinewave at 2 V RMS.

(4) Set the DVM to monitor AC voltage.

(5) Note the reading on the DVM (reading 1).

(6) Press the PSOH/LOCAL key and check that the LED above this key and that above the 2955 key are both on.

(7) Note the reading on the DVM (reading 2). This reading should be approximately 2 V.

(8) Check that reading 2 is within 6% of reading 1. If not, R170 on the personality board B4 requires adjustment.

(9) With the LF generator at 1 kHz, adjust the LF generator output level until the DVM reads 2.000 V. This sets the reference at 1 kHz.

(10) Set the LF generator to each of the frequencies given in Table 5-4 and check that the DVM readings fall within the limits given in the right-hand column.

TABLE 5-4 C-MESSAGE FILTER RESPONSE

Frequency Hz	Nominal level dB	V (2 V in)	DVM limits dB	V
90	-44.3	0.01219	-46.3 to -42.3	0.00968 to 0.01535
200	-25	0.11247	-27.0 to -23.0	0.0893 to 0.1416
300	-16.5	0.29925	-17.5 to -15.5	0.2667 to 0.3358
400	-11.4	0.53831	-12.4 to -10.4	0.47946 to 0.60399
500	-7.5	0.84339	-8.5 to -6.5	0.7516 to 0.9463
600	-4.7	1.16421	-5.7 to -3.7	1.037 to 1.3063
700	-2.7	1.46565	-3.7 to -1.7	1.3063 to 1.6445
800	-1.5	1.68279	-2.5 to -0.5	1.4998 to 1.888
900	-0.6	1.86651	-1.6 to +0.4	1.6635 to 2.094
1000	0	2.0000	Reference	Reference
1200	-0.2	1.95447	-1.2 to +0.8	1.7419 to 2.193
1300	-0.5	1.88812	-1.5 to +0.5	1.4998 to 2.1185
1500	-1.0	1.7825	-2.0 to 0.0	1.5886 to 2.0000
1800	-1.3	1.72199	-2.3 to -0.3	1.5347 to 1.932
2000	-1.3	1.72199	-2.3 to -0.3	1.5347 to 1.932
2500	-1.4	1.70227	-2.4 to -0.4	1.517 to 1.91
2800	-1.9	1.70705	-2.9 to -0.9	1.432 to 1.803
3000	-2.5	1.49979	-3.5 to -1.5	1.336 to 1.683
3300	-5.2	1.09908	-7.2 to -3.2	0.873 to 1.384
3500	-7.6	0.83374	-9.6 to -5.6	0.662 to 1.0496
4000	-14.5	0.37673	-17.5 to -11.5	0.2667 to 0.532
4500	-21.5	0.16828	-24.5 to -18.5	0.119 to 0.2377
5000	-28.5	0.07516	-31.5 to -25.5	0.0532 to 0.1062

FSK AND MANCHESTER DATA GENERATOR

The modem is tested during the instrument self-test. This can be used as an independent check when required.

Specification:

Manchester encoded NRZ data -

Deviation	±10% from 1 kHz to 10 kHz.
Data rate	± 1 bit per second at 10 kHz.

Test equipment:

Reference	Description	Minimum specification	Example
b	Counter/timer	Period measurement, ns range accuracy <±5 parts/10^6	Marconi 2437
c	Modulation meter	150 to 1000 MHz FM, noise averaging, LF output, measurement accuracy <2%	Marconi 2305

Procedure:

(1) Connect the 2955 RF IN/OUT N socket to the modulation meter RF input socket and connect the modulation meter LF output to the counter/timer as shown in Fig. 5-7.

(2) Switch on the Adapter on and press the CRTS key.

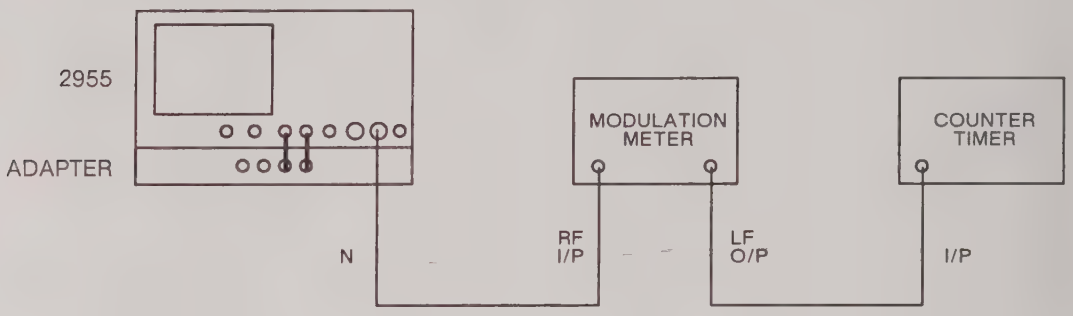

Fig. 5-7 Test equipment connections for FSK and Manchester data generator test

(4) Select MANUAL TEST and the signal tone mode. Set the data level to 8 kHz.

(5) The data modulated carrier level has to be increased for it to trigger the modulation meter. To achieve this, press 2955 and then RX. If the 2955 key is inadvertently pressed twice, the data is switched off. (To recover, press CRTS, 2955 and RX).

(6) In this mode, the carrier frequency reverts to a default value. If it is required to check the data deviation on a particular channel, set the RF generator to the corresponding channel frequency.

(7) Set the modulation meter to monitor FM noise average in a 50 Hz to 15 kHz bandwidth. Set the LF level potentiometer to the brown marker (2305).

(8) Set the counter/timer to measure period on the ns range. (This is required to achieve the correct accuracy and resolution.)

(9) Check on the modulation meter that the deviation displayed is within ±10% of that set.

(10) Check on the counter that the frequency indicated is 100000 ns ±10 ns.

DC METER

These tests are for voltage, current and power measurement accuracy.

Specification:

Voltmeter	±5% ±100 mV at 1 to 25 V.
Ammeter	±5% ±200 mA at 0 to 10 A.
Power meter	±10% ±20 mW at 100 mW to 200 W.

Test equipment:

Reference	Description	Minimum specification	Example
f	DVM	DC volts: 1 MΩ, accuracy <0.5%	Solatron 7150+ or Datron 1065A
g	Rheostat	0 to 100 Ω. 10 A	Berco
h	DC power supply	0 to 25 V, 10 A	Farnell B30/10
j	DVM current shunt	10 A, 0.25% accuracy, sensitivity 10 mV/A	Fluke 80J-10

Procedure:

(1) Connect the DC power supply to the Adapter's DC IN connectors, connect the DVM to the same connectors and connect the rheostat across the Adapter's DC OUT connectors as shown in Fig. 5-9.

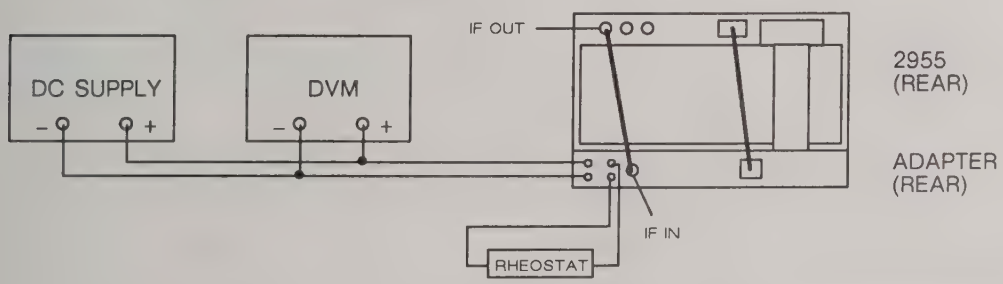

Fig. 5-9 Test equipment connections for DC meter test

(2) Switch on the equipment and press the CRTS key.

(3) When the instrument has completed its self-test, select MANUAL TEST.

(4) Adjust the rheostat to give a load resistance of 10 Ω.

(5) Set the DVM to read DC volts and then adjust the DC power supply to give a 10.00 V reading on the DVM.

(6) Check that the voltage displayed on the screen is within ±5% ±100 mV of the voltage indicated on the DVM.

(7) Check that the power reading displayed on the screen is equal to the current reading multiplied by the voltage reading.

(8) Repeat for voltages between 1 V and 25 V.

(9) Switch off the DC supply, disconnect the DVM and connect the current shunt across its inputs. Then reconnect the DVM in series with the positive supply as shown in Fig. 5-10.

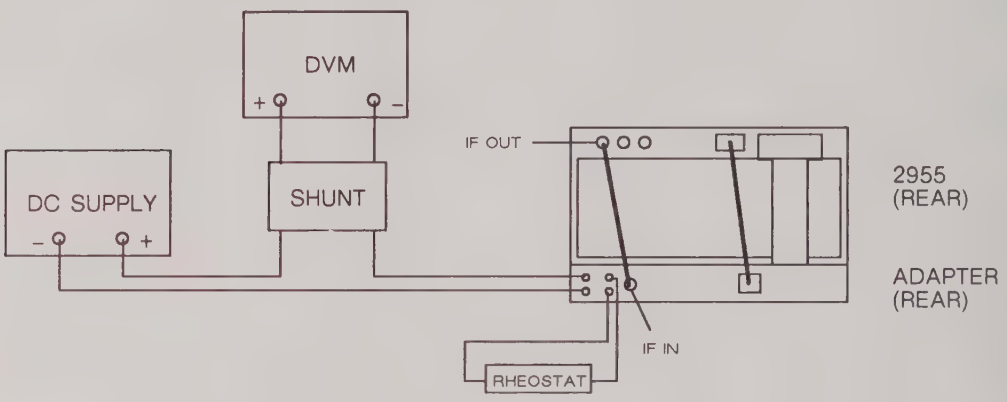

Fig. 5-10 Test equipment connections for DC meter test

(10) Set the rheostat to give a load resistance of 5 Ω.

(11) Set the DC power supply to give an output of 10 V and switch it on.

(12) Adjust the rheostat until the DVM indicates 20.0 mV (2 A).

(13) Check that the current reading displayed on the screen is within ±5% ± 200 mA of the current indicated on the DVM. (Every 10 mV displayed on the DVM is equivalent to 1 A.)

(14) Using the rheostat to adjust the current, repeat for DC levels on the DVM from 10 mV to 100 mV (1 A to 10 A).

EXTERNAL MODULATION

This test is for external modulation sensitivity.

Specification:

Sensitivity	0.5 V p-p for 5 kHz deviation ±10% at 1 kHz.

Test equipment:

Reference	Description	Minimum specification	Example
c	Modulation meter	300 Hz to 3.4 kHz filter, LF output, measurement accuracy <2%	Marconi 2305
e	Synthesized LF generator	1 kHz, 0.5 V pk-pk	R & S SPN or HP 3325
f	DVM	AC: RMS accuracy <0.5%,	Solatron 7150+ or Datron 1065A

Procedure:

(1) Connect the LF generator to the Adapter's EXT MOD INPUT socket and the DVM and connect the 2955 BNC RF IN/OUT socket to the modulation meter input socket as shown in Fig. 5-11.

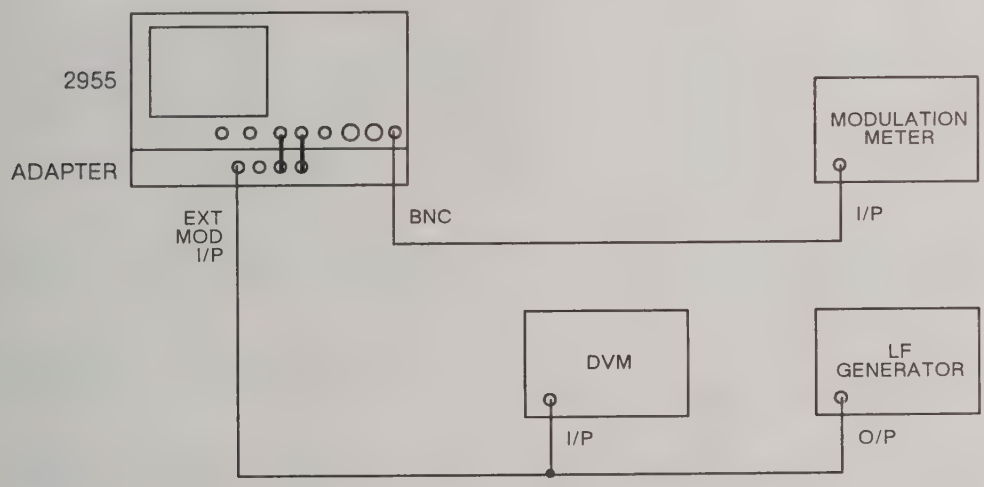

Fig. 5-11 Test equipment connections for external modulation test

(2) Switch on the equipment and check that the LED lights above the Adapter's 2955 key.

(3) Select RX mode and the RF IN/OUT BNC socket. Set the signal generator to a carrier frequency of 100 MHz, RF level to 0 dBm, modulation to 1 kHz, deviation level to 0 kHz, distortion to off and SINAD-S/N to off.

(4) Set the DVM to monitor AC volts RMS.

(5) Set the modulation meter to monitor FM with the 300 Hz to 3.4 kHz filter selected.

(6) Set the LF generator to give a 1 kHz sinewave output and adjust the level to give an RMS reading on the DVM of 176.7 mV.

(7) Check that the modulation meter reads 5 kHz deviation ±10%.

DISC DRIVE INTERFACE

The most convenient method of checking the performance of the disc drive interface is to ensure that a disc can be formatted correctly.

Specification:

Disc drive interface	Compatible with 3.5 or 5.25 inch, 40 or 80 track, single-sided or double-sided, single density disc drive with industry standard S.400 (Shugart) controller drive interface. Track to track stepping times of 6, 12, 20 and 30 ms are selectable.

Procedure:

(1) Insert a blank disc into the disc drive.

(2) Connect the disc drive to the DISC INTERFACE port on the right-hand side of the Adapter.

(3) Switch on the equipment.

(4) Press the DISC key to enter the DISC MENU. The Adapter attempts to read the disc directory. As the disc has not yet been formatted, DISC FAULT is displayed.

(5) Press the FORMAT key. The screen now displays DATA ON DISC WILL BE LOST PRESS ENTER TO CONFIRM.

(6) Press ENTER. When formatting has been completed, check that a catalogue of ten files is shown with NO FILE against each file.

SERIAL CONTROL PORT

In this test, two RF generator frequency settings (199 and 400 MHz) are checked by means of a program which is sent to the serial control port.

Specification:

Data rate	75 to 9600 baud.
Length	8 or 7.
Parity	Even, odd or none.
Stop bits	1 or 2.

Test equipment:

Reference	Description	Minimum specification	Example
k	Controller with serial interface	RS-232 compatible with selectable start, stop and parity	HP85 with serial interface

Procedure:

(1) Connect the RS-232 controller to the Adapter's SERIAL PORT.

(2) Enter the SERIAL INTERFACE MENU and set a BAUD RATE of 4800, LENGTH/PARITY to 8/EVEN and STOP BITS to 2.

(3) Enter and run a program which sets the 2955 RF generator to a specific frequency and then reads back the RF generator frequency to check that the command has been accepted and carried out. As an example, the following program is in HP-BASIC for an HP85 GPIB Controller:-

```
10 RESET 10                                  Resets controller serial
                                             control port.
20 SET TIMEOUT 10;5000
30 ON TIMEOUT 10 GOTO 330                    If any of the input/output
                                             commands take more than 5 s
                                             to complete (e.g. due to
                                             problem with controller
                                             connector or Adapter),
                                             program pauses and indicates
                                             a timeout has taken place.
40 CONTROL 10,3 ; 13,31,0                    Sets up controller serial
                                             port for 4800 baud rate,
                                             8-bit word length, even
                                             parity, 2 stop bits.
50 WAIT 500
60 OUTPUT 10 "CRTS" @ WAIT 1000              Commands Adapter to go into
                                             CRTS mode.
70 OUTPUT 10 "RD1"
80 ENTER 10 ; R$                             Performs a read command on
                                             the Adapter's serial buffer
                                             (to ensure that the buffer is
                                             empty).
90 CLEAR @ DISP "SETTING 400MHz FREQUENCY"   Clears controller screen and
                                             then displays SETTING 400 MHz
                                             FREQUENCY.
100 OUTPUT 10 "COM RGFR400MZ"                Commands Adapter to set an RF
                                             generator frequency of
                                             400 MHz.
110 OUTPUT 10 "NO"                           Sets Adapter into 2955 mode
                                             so that RF generator
                                             frequency can be seen on 2955
                                             screen.
120 WAIT 5000                                Program halts for 5 s.
130 OUTPUT 10 "CRTS"                         Commands Adapter back to CRTS
                                             mode.
```

```
140 OUTPUT 10 "RD27"                          Commands Adapter to put its
                                              RF generator frequency
                                              setting into its serial
                                              output buffer.
150 ENTER 10 ; R$                             Reads Adapter buffer.
155 R$=R$[1,12]
160 DISP
170 DISP "SET 400MHz ; READ ";R$              On controller screen,
                                              displays RF generator
                                              frequency set and RF
                                              generator frequency read.
180 P=1 @ IF R$ <> "400.00000MHz" THEN P=0    Compares frequency set with
                                              frequency read.  If not the
                                              same, pass/fail flag is set
                                              to fail.
190 DISP @ DISP "SETTING 199MHz FREQUENCY"    190 to 290 same as 90 to 180
200 OUTPUT 10 "COM RGFR199MZ"                 except frequency is 199 MHz.
210 OUTPUT 10 "NO"
220 WAIT 5000
230 OUTPUT 10 "CRTS"
240 OUTPUT 10 "RD27"
250 ENTER 10 ; R$
255 R$=R$[1,12]
260 DISP
270 DISP "SET 199MHz ; READ ";R$
280 IF R$<> "199.00000MHz" THEN P = 0
290 IF P=1 THEN P$ = "Passed" ELSE P$ = "Failed"
300 BEEP 20,100 @ WAIT 100 @ BEEP 20,100     Audio indication from
                                              controller to inform test is
                                              complete.
310 DISP @ DISP "TEST" ; P$                   Displays on controller screen
                                              TEST PASSED or TEST FAILED
                                              depending on pass/fail flag.
320 END                                       End of program.
330 DISP "TIMEOUT" @ BEEP @ PAUSE
```

PARALLEL CONTROL PORT

In this test, the data accuracy is checked by means of a program which is used to read and write to and from the parallel control port.

Specification:

Parallel control port	Centronics type 8 way bi-directional port. 4 TTL outputs (unprotected). 4 TTL inputs (unprotected). +5 V DC supply at 100 mA accessory power (unprotected).

Test equipment:

Reference	Description	Minimum specification	Example
m	Oscilloscope	DC to 5 V display	Tektronix 2235
n	GPIB controller	GPIB output port	HP85 with GPIB or 82937A

Procedure:

(1) Connect the GPIB controller to the public GPIB socket on the rear of the Adapter.

(2) Enter the GPIB INTERFACE MENU. Set the PUBLIC GPIB ADDRESS to 06 and the GPIB function to TALKER/LISTENER.

(3) Prepare a terminator as shown in Fig. 5-12. This is to be used as instructed on the controller display during the program. The terminator should not be used until asked for as the first checks would fail.

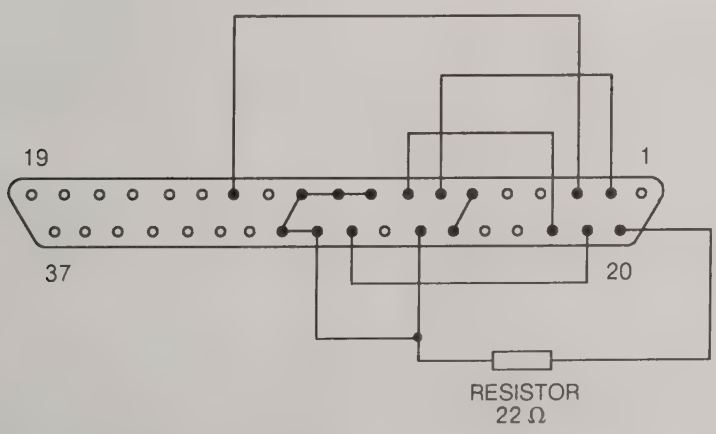

Fig. 5-12 Terminator connections for parallel control port test

(4) To enable the parallel control port to be written to and read from, either a GPIB or RS232C controller is required. The control program can then be either loaded as a user-defined program and stored on disc, if required, or the controller can directly command the parallel port. As an example, the following program is for an HP 85 GPIB Controller to directly control the port:-

```
 10 PRINT "PARALLEL PORT CHECKS"
 20 PRINT "====================="
 30 PRINT
 40 OUTPUT 706 ;"POI96,64"

 50 WAIT 1000
 60 OUTPUT 706 ;"POI88,255"
 70 CLEAR
 80 DISP "BI-DIRECTIONAL PORT
    OUTPUT CHECK";
 90 DISP ;"------------------
    ------------";
100 DISP
110 DISP ;" USE THE OSCILLOSCOPE
    TO CHECK CONNECTOR PINS 6,
    9,10,11,25,26,29,30 ARE ALL
    LOW";
120 DISP ;"WITH RESPECT TO GROUND
    PIN 27"
130 DISP
140 DISP "CHECK FOR 5 VOLTS BETWEEN
    THE SUPPLY OUT PIN 1 AND
    GROUND PIN 27"
150 DISP
160 DISP "PRESS <CONT> WHEN READY"
170 BEEP @ PAUSE
180 CLEAR
190 DISP "BI-DIRECTIONAL PORT OUTPUT
    CHECK";
200 DISP "-------------------------
    -----"
210 DISP
220 DISP "USE THE OSCILLOSCOPE
    TO CHECK CONNECTOR PINS 6,9,
    10,11,25,26,29,30 ARE ALL
    HIGH"
230 DISP "WITH RESPECT TO GROUND
    PIN 27"
240 DISP
250 DISP "PRESS <CONT> WHEN READY"
260 OUTPUT 706 ;"POI88,000"
270 BEEP @ PAUSE
280 GOSUB 800
290 IF A$="000" THEN LET H$="PASSED"
300 IF A$<>"000" THEN LET H$="FAILED"
    @ BEEP 500,50 @ BEEP 800,50
310 CLEAR
320 DISP "BI-DIRECTIONAL PORT INPUT
    CHECK";
330 DISP "-------------------------
    ------"
```

First, 8-bit bidirectional port is checked.

Sets bi-directional port to output data mode.

Sets all 8 bits low (inverted).

User is asked to check for a low on each line using oscilloscope.

User is asked to check for +5 V

User is asked to check that all lines are high. This checks that the port can output data correctly.

Sets all port lines high (inverted.)

Bi-directional port is checked to ensure that it reads data correctly. With nothing connected to the control lines, they float high. Controller reads port and ensures that result is 000 (inverted).

```
340 DISP
350 PRINT "BI-DIRECTIONAL PORT"
360 PRINT @ PRINT" SET READ
    PASS/FAIL"
370 PRINT "-----------------------
    ---------"
380 A1$="000"
390 PRINT USING 400 ; A1$,A$,H$
400 IMAGE XX,3A,6X,3A,8X,6A
410 DISP "CONNECT A CONNECTOR
    CONFIGURED AS IN DIAGRAM TO THE
    PARALLEL CONTROL PORT."
420 DISP
430 DISP "PRESS <CONT> WHEN READY"
440 BEEP @ PAUSE
450 GOSUB 800
460 IF A$="255" THEN H$="PASSED"
    ELSE H$="FAILED" @ BEEP 500,
    50 @ BEEP 800,50
470 CLEAR
480 DISP "BI-DIRECTIONAL PORT INPUT
    CHECK";
490 DISP; "-----------------------
    -----";
500 DISP
510 A1$="255"
520 PRINT USING 400; A1$,A$,H$
530 DISP
540 PRINT
550 T=0
560 T$="0"
570 CLEAR
580 DISP "TTL CONTROL CHECK"
590 OUTPUT 706 ;"POI96,255"
600 WAIT 200
610 GOSUB 890
620 PRINT "TTL CHECK HIGH";
630 IF T=255 THEN PRINT "PASSED"
    ELSE PRINT "FAILED" @ BEEP
    500,50 @ BEEP 800,50
640 PRINT
650 OUTPUT 706 ;"POI96,000"
660 GOSUB 890
670 PRINT "TTL CHECK LOW";
680 IF T=16 THEN PRINT "PASSED"
    ELSE PRINT "FAILED" @ BEEP 500,
    50 @ BEEP 800,50
690 PRINT
700 CLEAR
710 PRINT
720 PRINT "       TEST COMPLETE
    "
730 BEEP @ BEEP
740 DISP " TEST COMPLETE REMOVE
    CONNECTOR"
750 FOR X=1 TO 5
760 PRINT
770 NEXT X
```

User is asked to connect a terminator to the parallel control port. This pulls the 8 bi-directional port lines low. Also, 4 TTL outputs are routed to 4 TTL inputs.

Controller reads port and ensures that result is 255.

Sets the four TTL output lines high.

Controller reads 4 TTL inputs and checks result.

Sets the four TTL output lines low. Controller reads 4 TTL inputs and checks result.

```
780 LOCAL 706
790 END
800 FOR X=1 TO 3
810 OUTPUT 706 "POI96,16" @ OUTPUT
    706 "POI96,80"
820 OUTPUT 706 "PEI88"
830 WAIT 200
840 ENTER 706 ; R$
850 WAIT 200
860 IF X=3 THEN LET A$=R$
870 NEXT X

880 RETURN
890 ! TTL IN/OUT CHECK
900 FOR X=1 TO 3
910 WAIT 200
920 OUTPUT 706 ;"PEI96"
930 WAIT 200
940 ENTER 706 ; T$
950 IF X=1 OR X=2 THEN GOTO 970
960 LET T=VAL(T$)
970 NEXT X

980 RETURN
990 END
```

Sets the bi-directional port to read data.

Reads the result of the bi-directional post (3 times to obtain correct result).

Reads the result of the four TTL inputs.

2957A

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